Ohio Nutrient Reduction Strategy

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Preface

The Ohio Nutrient Reduction Strategy is an assessment of current efforts to reduce the negative impacts on Ohio's water resources. These impacts are attributed to both point and nonpoint sources of phosphorus and nitrogen. The strategy recommends voluntary practices and regulatory based initiatives designed to reduce nutrient losses in runoff and subsurface drainage and to remove nutrients through point source treatment technologies. The major programmatic initiatives being carried out by Ohio EPA, Ohio Department of Natural Resources, the Ohio Department of Agriculture and other organizations are described, including certain possible refinements in legislative authority that are being discussed.

This strategy is an outgrowth of Ohio's participation on the Mississippi River/Gulf of Mexico Watershed Nutrient (Hypoxia) Task Force as well as requests from U.S. EPA Region 5 to produce a state strategy as called for in the 2008 Gulf Hypoxia Action Plan[1]. Ohio's Nutrient Reduction Strategy is being submitted to Region 5 in fulfillment of federal grant work plan commitments. The document follows the suggested framework for state nutrient strategies set out in a U.S. EPA guidance memorandum[2]. Wherever possible and logical the contributions made by stakeholder workgroups have been incorporated. The work product and recommendations to be made by the Ohio Lake Erie Phosphorus Task Force – Phase II will be a valuable companion report designed to address the local conditions found in the western Lake Erie basin.

The strategy presented in this report is one of many concurrent efforts in a multi-year effort to reduce nutrient pollution in Ohio's surface waters. Clean water is important to Ohio's economy and present trends in nutrient pollution cannot be allowed to continue. From the information presented here it is clear that sustained action is needed and must involve many diverse sectors of Ohio's economy: farmers, agri-business, industry, trade associations, municipal and county governments, environmental groups as well as the general public. The task ahead is to find cost effective means to reduce the delivery of nutrients present in point source effluents and in nonpoint source (NPS) runoff from urban and agricultural land use. And this must occur in a manner that does not interfere with Ohio's overall economic recovery.

[1] Mississippi River / Gulf of Mexico Watershed Nutrient Task Force. 2008. Gulf Hypoxia Action Plan 2008 for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico and Improving Water Quality in the Mississippi River Basin. Washington, D.C.

[2] Memorandum dated March 16, 2011 from Nancy Stoner, Acting Assistant Water Administrator, U.S. EPA to Regional Administrators, Regions 1-10.

1.0 Introduction

Water pollution caused by excessive amounts of nutrients has worsened in recent years and now threatens Ohio's most valuable natural resource areas. This reality is apparent if one looks at the conditions on some of Ohio's waterways:

- harmful algal blooms (HABs) are becoming more common on Lake Erie and some Ohio lakes;
- periodic recreational advisories;
- widespread nuisance growths of aquatic vegetation;
- increased water treatment costs for clean public water supplies
- changes in aquatic communities and declining fisheries;
- renewed concern over the increased size of anoxic areas in Lake Erie (see box); and
- fewer dollars being spent on water based recreation and tourism.

To address these problems Ohioans need to make fundamental changes regarding the management of agricultural and urban landscapes to minimize the loss of nutrients to our waterways. Further consideration must be given to the design, construction and operation of nutrient removal technologies at wastewater treatment facilities. The nature of these changes and the approaches taken by governmental agencies, agri-businesses, farmers, landowners, wastewater treatment service providers and researchers are must be constructively debated and quickly implemented if further damage to the environment is to be avoided. The purpose of this document is to provide a useful, widely accepted framework to develop and implement nutrient reductions strategies in Ohio waters.

Lake Erie Anoxia

In the past few years, concern has risen about the increasing size of the area of anoxia at the bottom of the central basin. This condition develops in late summer when oxygen in the hypolimnion of the central basin becomes depleted following bacterial decomposition of dead algae and other organic materials. Thermal stratification of the water prevents surface water oxygen from being remixed into the deeper waters. The result is an area in which most organisms are unable to survive. To some degree, anoxia occurs as a natural event, however, the unexpected increase in area suggested something more than natural conditions.

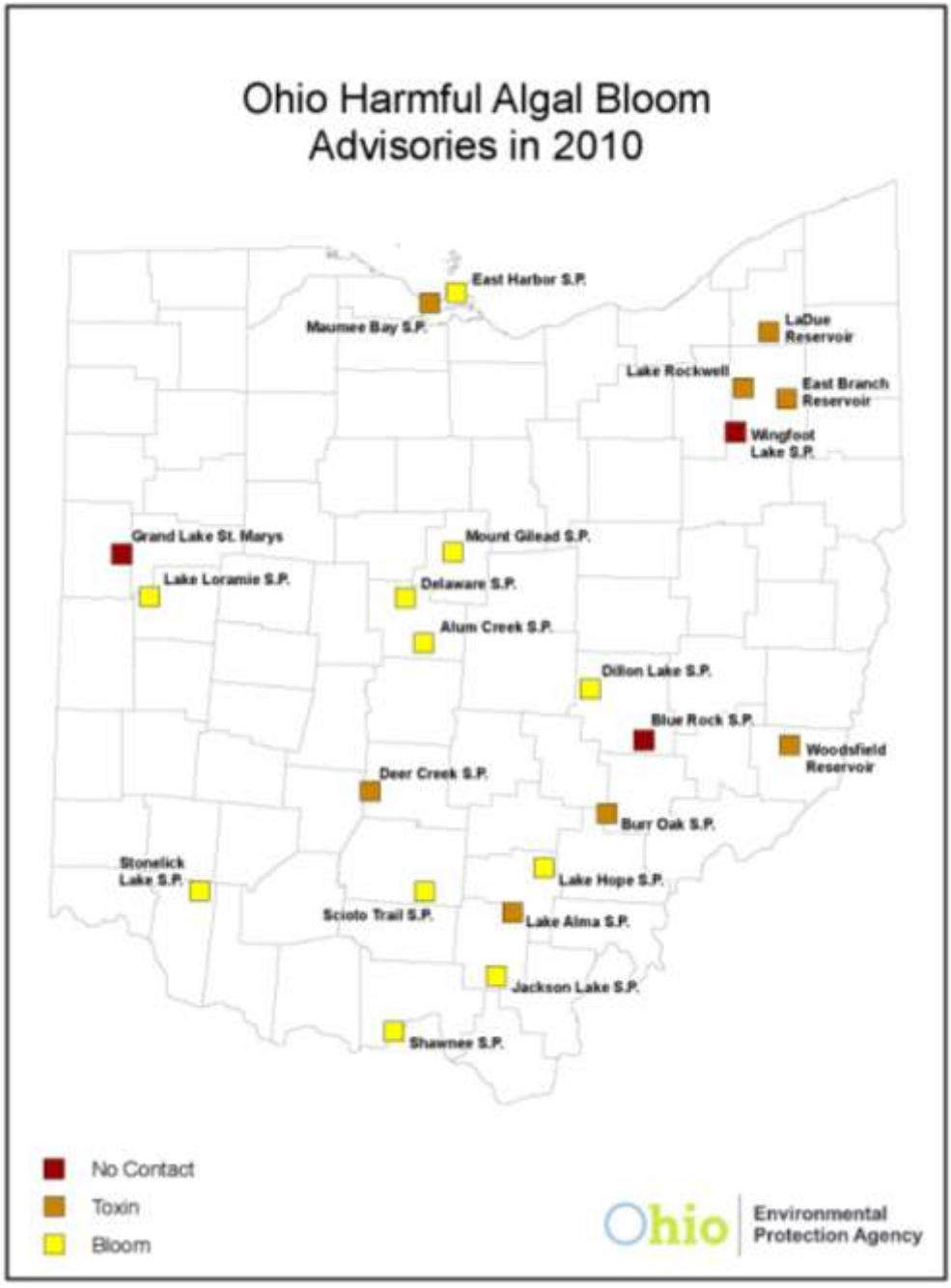
The increased area of anoxia and higher phosphorus concentrations in the lake during spring months led the U.S. EPA to fund a two-year study to determine why this is occurring. Numerous researchers on both the U.S. and Canadian sides of the lake are cooperating in this investigation. Increased phosphorus concentrations in the lake are a suspected cause of the expanded anoxic area. Invasive species such as zebra mussels, quagga mussels, and gobies may also be altering Lake Erie's ecosystem in as yet unknown ways to contribute to the anoxia. Other suspected causes are low lake levels, changing weather patterns, and alterations in the internal processes in the lake. (State of the Lake Report, 2004. Ohio Lake Erie Commission)

Recent Trends

Impacts caused by nutrient pollution have become more evident in the past several years. The summer of 2010 exhibited some of the worse water quality conditions in recent memory at inland lakes and Lake Erie beaches. Blooms of cyanobacteria were seen in Grand Lake Saint Marys and 19 other inland lakes (see Figure 1). Extensive blooms covered western Lake Erie in 2010 and 2011. Lower than normal precipitation in 2012 produced lower phosphorus export from the Maumee River basin resulting in a smaller algal bloom[3].

[3] NOAA (2012) Harmful Algal Blooms (HAB) in Lake Erie: Experimental HAB Bulletin Archive. (NOAA, Silver Spring, MD).

Figure 1. Ohio lakes where public health advisories were posted in 2010 due to potentially harmful algal blooms.



These blooms prompted advisories to limit recreation in and on the water. Other types of aquatic vegetation reached nuisance levels by fouling boat motors and washing up on beaches. As a result local communities saw dramatic declines in tourism and its associated economic activity causing economic hardship for small business owners. Drinking water supplies experienced taste and odor problems and increased water treatment costs. The presence of toxins produced by cyanobacteria was detected in raw water supplies and trace amounts were occasionally detected in treated water. Fortunately there were

no interruptions to drinking water supplies in 2010, but given the toxin levels recorded the future risk of service interruptions is real.

In the face of this evidence most water resource professionals agree that nutrient enriched waters have reached a critical stage and that immediate actions must be taken to reduce the amount of nutrients reaching our waterways. The search for solutions to water pollution problems can begin by looking at existing federal and state authorities. However, as this report will describe, that search has failed to identify a complete set of solutions that are adequately funded and fully capable of delivering solutions. Ohioans will need to use innovation and initiative to solve these problems and protect Ohio's water.

2.0 Public and Stakeholder Involvement

In November 2011 Ohio submitted to Region 5 a framework for a statewide nutrient reduction strategy[4]. This framework was prepared by Ohio EPA in collaboration the Ohio Department of Agriculture (ODA) and the Ohio Department of Natural Resources (ODNR). The document was made available to the public and the Directors of the three state agencies worked together, meeting with stakeholders and work groups to effectively foster public input and recommendations. The primary public involvement efforts are summarized below.

1. Lake Erie Phosphorus Task Force – The task force was established in 2007 and included experts from academia, state and federal government agencies, agri-business , environmental groups and other stakeholders. Additional Information is available online at http://epa.ohio.gov/portals/35/lakeerie/ptaskforce/Task_Force_Final_Report_April_2010.pdf
2. Lake Erie Phosphorus Task Force Phase II – Convened in February 2012 and comprised of the same suite of interest groups used in the original Task Force. Participants have focused on developing phosphorus targets for western Lake Erie tributaries and identifying other methods that will be needed to reduce nutrient loading. The final report is due in later in 2013. Additional Information is available online at http://www.epa.ohio.gov/dsw/lakeerie/index.aspx#LiveTabsContent125072.
3. The Directors' Agricultural Nutrients and Water Quality Working Group – The group, established by the directors of Ohio EPA, ODA and ODNR, was convened in August 2011 and was comprised of a wide base of interest groups. Participants included representative s from all the major agricultural commodity groups, environmental groups and individual farmers. They were charged with recommending how to reduce nutrients that reach surface waters from agricultural production practices. The directors collectively reviewed the work of the group and made a number of recommendations to Governor Kasich in March 2012. Those recommendations are included throughout this strategy. The complete report is available on line at http://www.agri.ohio.gov/topnews/waterquality/docs/FINAL_REPORT_03-09-12.pdf.
4. The Point Source Urban Work Group – This was a small work group comprised of consulting. engineers, environmental groups and wastewater utility operators of large and small facilities. The group identified some immediate steps that publicly owned treatment works (POTWs) can

[4] Ohio EPA 2011. Nutrient Reduction Strategy Framework for Ohio Waters (Draft) Ohio EPA, Division of Surface Water. November 15, 2011.

take to improve nutrient removal at existing facilities. The group also identified likely roadblocks to achieving overall nutrient reduction targets in Ohio. Recommendations from the group appear in the text box to the below. The complete report is available online at http://epa.ohio.gov/portals/35/documents/point_source_workgroup_report.pdf.

5. Ohio Nutrient Forum Visioning Workshop, November 15, 2012 – This workshop provided the opportunity for the public to hear about Ohio's nutrient reduction efforts and strategy development, ask questions and offer input. Over 200 citizens attended the event. Information and a complete summary of the workshop are available online at http://epa.ohio.gov/Portals/35/visioning_workshop/meetingsummary.pdf.

Point Source and Urban Nutrient Workgroup Recommendations

Ohio EPA should develop a state-wide nutrient mass balance sheet that accounts for point and non-point sources of nutrients.

Ohio EPA should encourage and promote operational experimentation at wastewater treatment facilities aimed at achieving low cost nutrient removal.

Wastewater treatment plant owners should be prepared to determine cost effective means to achieve lower effluent limits wherever facilities are shown to be significant contributors to nutrient enrichment.

State government should appoint a panel of economic, financial, and policy experts to consider options for funding the implementation of Ohio's nutrient reduction strategy.

Ohio EPA should publish an annual report on nutrient loadings and resulting water quality conditions in our lakes and rivers.

Ohio EPA should integrate watershed management and green infrastructure planning with Ohio's nutrient reduction strategy.

3.0 Overall Strategies for Priority Setting

A broad framework for the prioritization of nutrient reduction efforts was described in the report[5] on the Director's Agricultural Nutrient Water Quality Working Group (DANWQWG). The overall objective is to achieve and maintain a level of land and water stewardship that eliminates nutrient pollution (level 3). Where nutrient pollution is evident the highest priority for corrective actions should be given to areas with the distressed watershed designation (level 1) followed by areas defined as critical natural resource areas (level 2).

Key message:

Lake Erie is the State's most valuable water resource. Thus the western Lake Erie Basin is a priority watershed for addressing excessive loadings of dissolved and total phosphorus from agricultural runoff and point sources. Grand Lake St Marys, Ohio's largest inland lake straddling the Lake Erie and Wabash watersheds, also merits priority for similar reasons. The Great Miami and Scioto River basins in the Ohio River drainage are priority areas for nutrient reduction efforts by virtue of their relatively high nutrient export rates and proportion of HUC12 watersheds with nutrient impairments.

"Given the vast differences in the intensity, type and concentration of agricultural production in Ohio's watersheds, and the significant variations in the geography, surrounding land uses and overall health of watersheds throughout the state, a framework for prioritization is needed to ensure that effort and resources are strategically directed towards maximizing results.

Therefore, a three-tiered system of watershed classification should be utilized that prioritizes all of the recommendations discussed below, with regard to changes in production practices, direction of available programming dollars, and focus of research. At the same time, any potential regulatory changes should be incrementally implemented in accordance with this three-tiered prioritization structure.

A. Level 1: Watershed in Distress (e.g., Grand Lake St Marys)
Watersheds in distress (as designated by the Chief of the Division of Soil and Water Resources) are those in which the deterioration of water quality is such that exposure would likely be harmful to the health of humans that come in contact with or consume it.

B. Level 2: Critical Natural Resource Areas (e.g., Western Lake Erie Watershed)
Critical Natural Resource Areas are defined in the Ohio Revised Code as an area, identified by the Director of Natural Resources, in which occurs a natural resource that requires special management because of its importance to the well-being of the surrounding communities, the region, or the state.

C. Level 3: Statewide (i.e., Majority of state that is not in a Level 1 or 2 area)
Watersheds in the state not classified as Level 1 or Level 2 watersheds but in which many of the nutrient management practices described below are not required but are recommended. At each level, a process/trigger for developing nutrient management plans, programs and procedures should be developed including a separate Nutrient Management Plan process for farms involved in livestock production (permitted & non-permitted) and crops. On those farms where both livestock and crops are produced, the plan would incorporate both aspects.

In utilizing this overall framework to implementing any recommendations, the primary goal is ensure that any given watershed in the state is eventually moved to a Level 3". (DANWQWG 2012).

[5] Directors Agricultural Nutrient Water Quality Working Group – Final Report and Recommendations. 2012. Ohio Department of Natural Resources, Ohio Environmental Protection Agency, Ohio Department of Agriculture.

The following strategic principles will be applied to further prioritize Ohio's nutrient reduction efforts to where ever the best outcomes are expected:

- Work to improve the implementation of approved Total Maximum Daily Load (TMDL) studies and watershed plans;
- Align grant funding resources directly to Ohio's water quality goals;
- Funding projects that eliminate impairments and restore impaired waters; and
- Protecting high quality waters from degradation.

4.0 Watershed Priorities

Ohio has identified six large drainage basins comprised of 15 HUC 8 units and over 660 HUC 12 units as priority nutrient reduction areas (see Table 1). Eight of the 15 HUC 8 watersheds listed in Section 3.2 encompass the Level 1 and Level 2 priority areas described above. Seven additional HUC 8 watersheds described under the Level 3 priority scheme were selected for priority attention based upon estimated export of nutrients to downstream waters (Figures 2 and 3). Furthermore, a high percentage of streams within these watersheds are impaired by nutrients. Within these 15 HUC 8 units there are over 220 approved TMDLs for nutrients and 26 approved watershed action plans (WAPs) (see Figure 4). These TMDLs and final WAPs provide a good foundation to leverage Section 319 and other grant funds to assist with implementing practices that effectively address nutrient loadings.

To effectively do the most good in the shortest time we need information regarding which HUC 12 watersheds have the highest nutrient loadings and what lakes and stream segments have the greatest potential to recover from nutrient pollution. Equally important is knowledge about the "institutional readiness" in place to deliver needed improvements (for example, lower NPDES permit limits, site specific application of nonpoint BMPs or improved stream habitat) and the public's willingness to own the problem and implement solutions. Ohio will target implementation resources based on both of these factors. The targeted watershed approach and several specific case examples are presented below.

Table 1. Priority watersheds for nutrient reduction efforts in Ohio.

Drainage Basin / Major River	HUC 8 ID numbers	Watersheds	Basis for Priority
Lake Erie Basin (288 priority HUC 12 units)			
Maumee River	04100003 04100004 04100005 04100006 04100007 04100008 04100009	St Joseph St Marys Upper Maumee Tiffin Auglaize Blanchard Lower Maumee	The Maumee River is the largest tributary to Lake Erie. Conditions found in the western basin have been linked with loadings from the Maumee and Sandusky watersheds, and is largely attributable to agricultural land use.
Sandusky River	04100011	Sandusky	See above
Cuyahoga River	04110002	Cuyahoga	Highest percentage of urban land use and somewhat higher proportion of Point Source associated nutrient load; nutrient TMDLs or watershed action plans completed for 100% of watershed.
Ohio River Basin (370 priority HUC 12 units) + Wabash			
Great Miami River (GMR)	05080001 05080002	Upper GMR Lower GMR	Contributes significant nutrient loading from both agricultural land use and urban nonpoint and point sources; achieving load reductions would help reach Gulf hypoxia goals.
Scioto River	05060001 05060002 05060003	Upper Scioto Lower Scioto Paint	Contributes significant nutrient loading from both agricultural land use and urban nonpoint and point sources; achieving load reductions would help reach Gulf hypoxia goals.
Wabash River	05120101	Upper Wabash	Agricultural NPS nutrient loading impacting Grand Lake St. Marys; declared a distressed watershed under state regulations (ORC: 1501:15-5-20 Designating Watersheds in Distress).

Figure 2. The annual delivered accumulated load of total phosphorus at 20 major watershed outlets in Ohio (from USGS SPARROW model output).

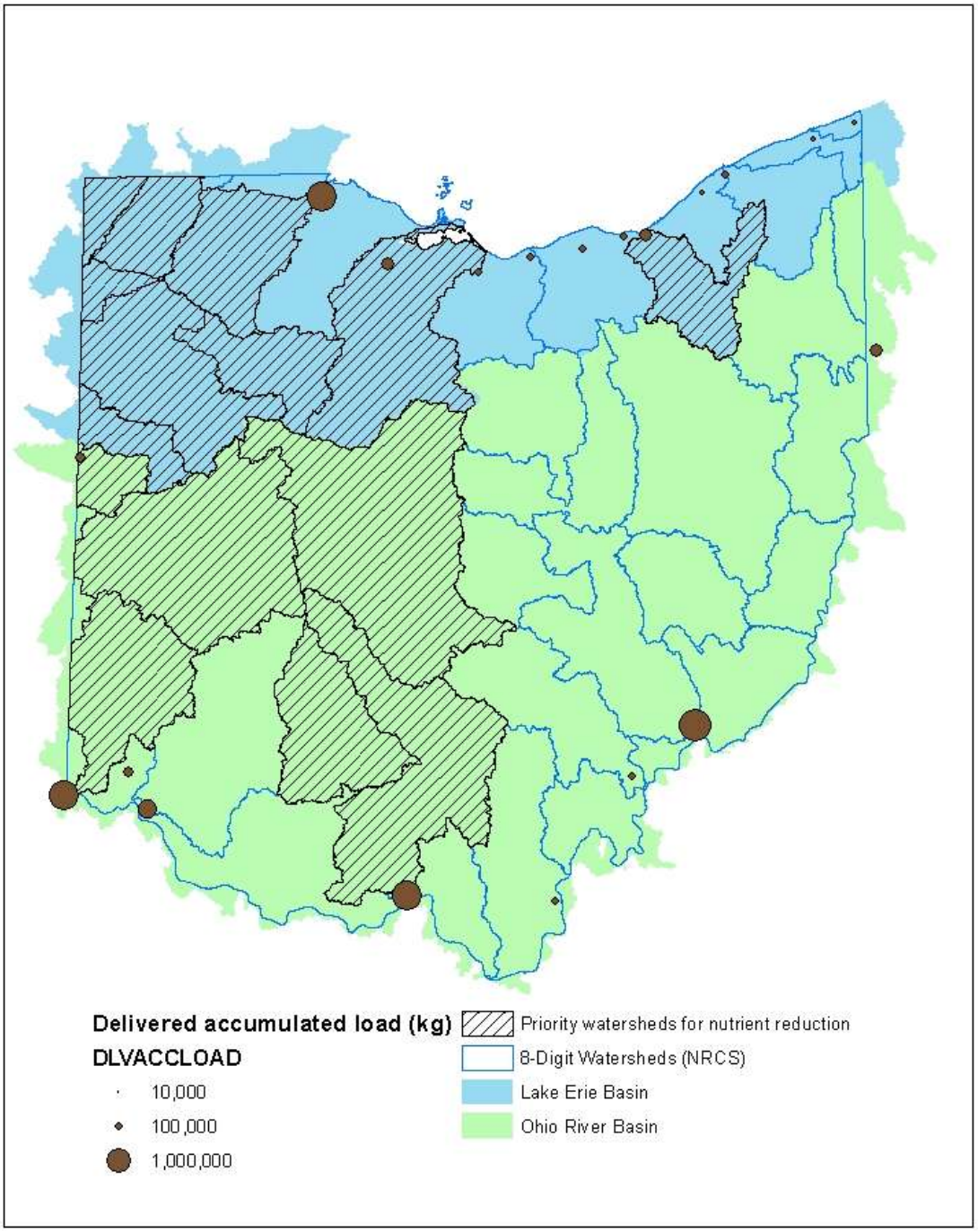


Figure 3. The annual delivered accumulated load of total nitrogen at 20 major watershed outlets in Ohio (from USGS SPARROW model output).

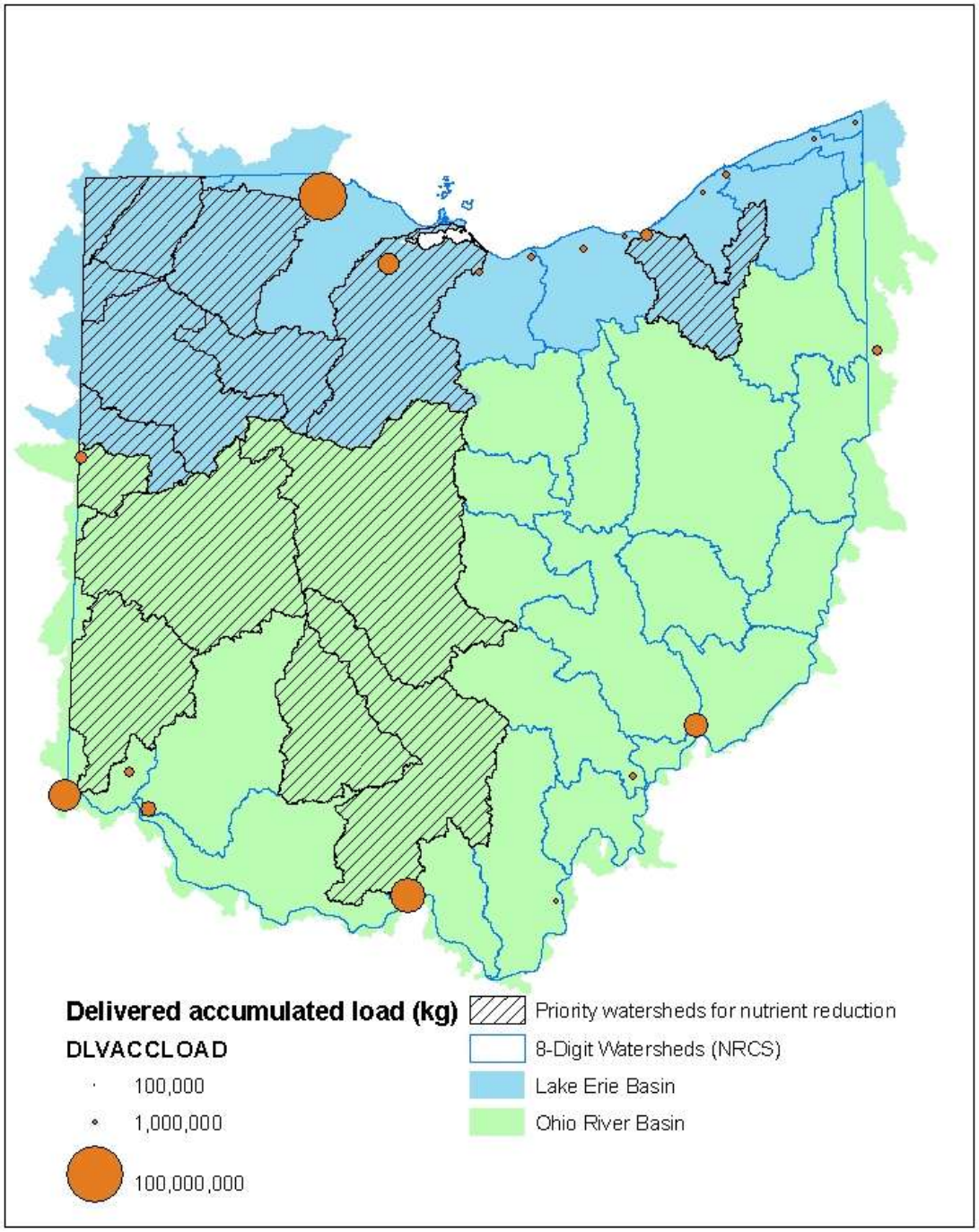
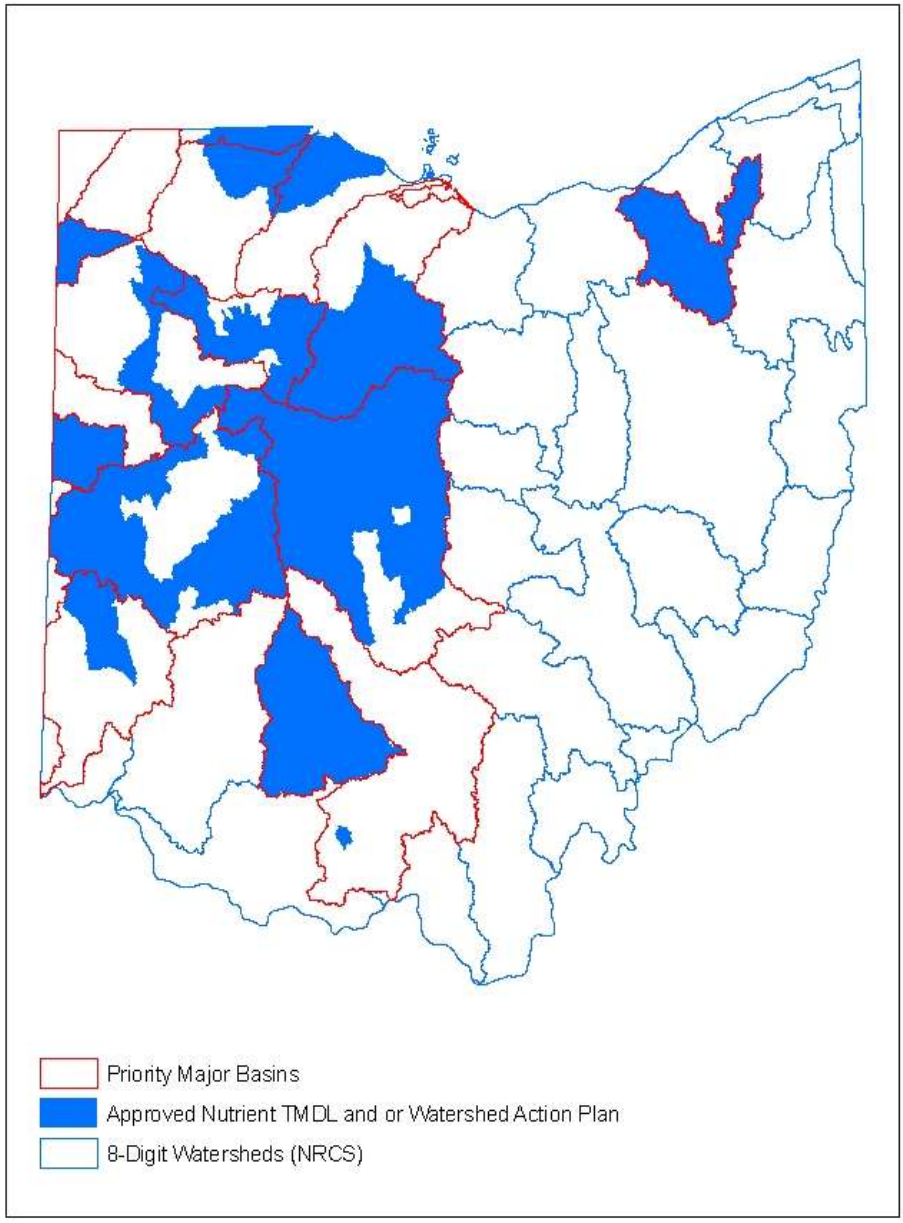


Figure 4. Watersheds located in the six priority river basins with either an approved TMDL or watershed action plan as of May 2013.



Export of Nutrients to Ohio River and Gulf of Mexico

Analysis performed by USGS using the SPARROW model on nutrient flux (mass per time) delivered to the Gulf of Mexico from States in Mississippi and Atchafalaya River basins indicates Ohio contributes 5.4 and 4.1 percent of the total flux of total nitrogen and total phosphorus respectively. Watersheds within or partially within Ohio that have the highest nutrient flux are located in western, west central Ohio and southwest Ohio (Table 2). The SPARROW model output for phosphorus flux generally comport very well with Ohio EPA's field survey based observations regarding watersheds with a high degree of nutrient enrichment.

Table 2. Ohio watersheds in the Ohio River Basin with the highest nutrient flux (USGS SPARROW model results). Ohio River Basin priority nutrient reduction areas are highlighted.

High Nutrient Flux Category	Watershed (HUC 8 #)	N Flux (kg/km^2)	P Flux (kg/km^2)
N & P	Upper Wabash (05120101)	2159	254
N	Upper Great Miami (05080001)	1790	50
N	Upper Scioto (05060001)	1786	88
N & P	Lower Great Miami (05080002)	1735	127
N	Little Miami (05090202)	1653	99
N	Paint (05060003)	1405	65
N & P	Mill Creek (05090203)	1345	174
P	Ohio Brush-Whiteoak (05090201)	1218	126

Targeted Watersheds and NPS Implementation Strategies

The implementation of agricultural practices designed to reduce nutrient loadings to Ohio's streams has generally followed a traditional USDA Natural Resource Conservation Service (USDA-NRCS) system of "countywide distribution" of Environmental Quality Incentives Program (EQIP) dollars and similar program funding. This often results in conservation practices spread too thin over too big an area to be effective at improving water quality. Additionally, the practices selected for implementation do not always have the expected degree of water quality benefit. For example, over the past eleven years Lake Erie Conservation Reserve Enhancement Program (CREP) funding has installed more than 67,000 acres of conservation practices such as grass filter strips. While these practices reduce sediment and particulate phosphorus in lakes and streams they don't address the emerging problems associated with the delivery of dissolved reactive phosphorus to waterways.

Adjustments in federal, state and county level programmatic thinking is needed to more effectively target available conservation funding. A highly targeted effort consisting of a wide array of effective conservation practices concentrated in a small geographic area where nutrient enrichment is a known water quality problem will significantly improve water quality. This approach would prioritize efforts in areas identified in watershed action plans or TMDL reports. Using this framework Ohioans need to identify innovative methods for implementation that will lead to more tangible results. First of all, focus areas need to shrink to more manageable geographical areas. The following guidelines are offered for implementing highly targeted nutrient reduction strategies:

1. All activities should be limited to a single 12-digit HUC unit. Typically this size HUC covers a drainage area of 25 to 30 square miles or about 18,000 acres.
2. Within this HUC demonstration area, at least 75 percent of all farm operations within the HUC should have a whole farm conservation plan completed and in place.
3. At least 75 percent of all farms will install grassed waterways wherever appropriate drainage ways or areas highly vulnerable to erosion exist.
4. 50 percent of all farm operations in the HUC will add cover crops as part of a conservation crop rotation.
5. All farms will conduct soil tests on a 3-year basis PRIOR to applying fertilizer and/or animal manure.
6. 50 percent of all farms will maintain wetland areas and/or riparian zones enrolled in long term land retirement programs such as CRP and/or CREP.
7. All operations with livestock will complete manure management plans.
8. All livestock operations will exclude stock from streams and waterways.
9. 10 percent of farms within the HUC will install drainage water management practices.
10. Farmers will maintain riparian areas in natural vegetation, including trees. Farmers agree to maintain sufficient riparian areas as "No Plow Zones".

Local Soil and Water Conservation Districts (SWCDs) play an important role in this process. Such demonstration areas would be funded using a combination of USDA Farm Bill programs, Conservation Innovation Grants and/or Ohio EPA section 319 and/or Division of Environmental and Financial Assistance (DEFA) Linked Deposit funds. It is anticipated that five or six of these "Demonstration Watersheds" would be implemented statewide. Comprehensive water quality monitoring would be conducted annually for the demonstration period to be able to document any water quality improvements that are resulting from these concentrated practices.

Lake Erie Nutrient Reduction Demonstration Watershed

The Lake Erie Nutrient Reduction Demonstration project (LENRD) will demonstrate the value of targeting limited funding into highly concentrated land areas. The anticipated outcome is to produce measurable reductions in nitrogen, phosphorus and sediment loadings to streams in agricultural areas. Ohio EPA through the Division of Surface Water Nonpoint Source Program will collaborate with the Soil & Water Conservation District (SWCD) in Crawford County, the Sandusky River Watershed Coalition, local Natural Resource Conservation Service (NRCS) personnel and the Ohio State University Extension staff to implement this project within the Loss Creek HUC 12 sub-watershed. Ohio EPA will subgrant much of the requested funding to the SWCDs to organize and encourage landowners within the sub watershed. Funds will also be directed to the Watershed Coalition and the Ohio State University Extension to use social indicators to measure changes in landowner attitudes and behaviors. A subgrant to the SWCD will be used primarily to implement a variety of nutrient reduction and nonpoint source management practices including:

- Whole farm conservation plans
- Cost-share funding to implement nutrient reduction BMPs identified in farm plans
- Cover crops as part of a conservation crop rotation
- Comprehensive nutrient management plans for livestock producers
- Replacement and/or repair of failing home sewage treatment systems
- Livestock exclusion fencing and alternative watering supplies
- Controlled drainage and/or other practices to reduce rate and amount of runoff
- Filter area wetland creation and/or restoration

Powell Creek Targeted Nutrient Reduction Project

The Powell Creek-Targeted Nutrient Reduction Project will demonstrate the value of targeting limited funding into concentrated land areas. The anticipated outcome is to produce measurable reductions in nitrogen, phosphorus and sediment loadings to streams in agricultural areas. Ohio EPA through the Division of Surface Water Nonpoint Source Program will collaborate with the Soil & Water Conservation Districts in Putnam, Defiance, Henry and Paulding counties. Funds will also be directed to the Ohio Department of Natural Resources –Division of Soil and Water Resources, and local NRCS personnel to implement this project within the Powell Creek HUC 10 sub-watershed. Ohio EPA will subgrant much of the requested funding to the Defiance and Putnam county SWCDs to organize and encourage changes in nutrient management planning and landscape management practices by landowners and/or livestock and row crop land managers. A subgrant to the Defiance SWCD will be used primarily to implement a variety of nutrient reduction and nonpoint source management practices including:

- Whole farm conservation plans
- Cost-share funding to implement nutrient reduction BMPs identified in farm plans
- Filter Areas (designed per Ohio NRCS-FOTG 393) or filter recharge areas (As provided in Lake Erie CREP) , and/or wooded riparian buffers
- Wetland restoration or creation
- Precision nutrient application
- Cover crops as part of a conservation crop rotation
- Restore channels with two-stage, over-wide and/or natural channel designs
- Fix failing on-site household sewage disposal systems
- Note: targeted controlled drainage project proposed by ODNR, if funded, would likely be implemented concurrently with this proposal.

Lye Creek (Headwaters Blanchard River Watershed)-Sediment and Phosphorus Reduction Project

The Lye Creek Sediment and Phosphorus Reduction Project will demonstrate the value of targeting limited funding into concentrated land areas. The anticipated outcome is to produce measurable reductions in phosphorus and sediment loadings to streams in this predominately agricultural 12-digit HUC watershed. Ohio EPA through the Division of Surface Water Nonpoint Source Program will collaborate with the Hancock County Soil and Water Conservation District (SWCD) Program Administrator and District Technicians, the Ohio Department of Natural Resources –Division of Soil and Water Resources, and local NRCS personnel to implement the Lye Creek project. Ohio EPA will administer a subgrant to the Hancock SWCD to organize and encourage changes in nutrient management planning and landscape management practices by landowners and row crop land managers. The subgrant to Hancock SWCD will be used primarily to implement a variety of nutrient reduction and nonpoint source management practices including:

- Edge of field filter areas and/or riparian buffers
- Grassed waterway installation
- Conservation tillage adoption
- Cover crops as part of a conservation crop rotation
- Installation of tile control structures
- Repair tile main blowouts

A separate project under ODNR targeting controlled drainage is being implemented concurrently with this proposal. Ohio EPA has also provided a subgrant to the Hancock County Board of Health to aid and facilitate the repair and replacement of home sewage treatment systems in the Lye Creek watershed. Lastly, Ohio EPA and the Hancock County Park District hope to collaborate to restore riparian habit along Lye Creek near the confluence of Lye Creek and the Blanchard River.

National Water Quality Initiative USDA-NRCS

Through the National Water Quality Initiative (NWQI), the Natural Resources Conservation Service (NRCS) offers financial and technical assistance to farmers and forest landowners interested in improving water quality and aquatic habitats in priority watersheds with impaired streams. As part of this initiative, NRCS helps producers implement conservation and management practices through a systems approach to control and trap nutrients and/or manure in runoff and drainage water in priority watersheds with impaired waters. Qualified producers will receive cost-share assistance for installing conservation practices specifically intended to improve water quality. Ohio NRCS intends to would work with Ohio water quality authorities and federal agencies including, among others, the U.S. Geological Survey and the U.S. Environmental Protection Agency, to monitor the environmental outcomes of the Initiative.

Table 3. Watersheds in Ohio selected for the USDA-NRCS National Water Quality Initiative program.

Year	Watershed Name	HUC 12 unit	Area (acres)
2012	Pipe Creek-Frontal Sandusky Bay	041000110102	31,037 acres
2012 & 2013	East Branch South Fork Sugar Creek	050400011002	18,043 acres
2012	Tommy Run-Chippewa Creek	050400010205	23,460 acres
2013	Brandywine Creek-Broken Sword Creek	41000110301	35,621 acres
2013	Fivemile Creek – East Fork Little Miami River	50902021101	27,241 acres

5.0 Set Watershed Load Reduction Goals

Key message:

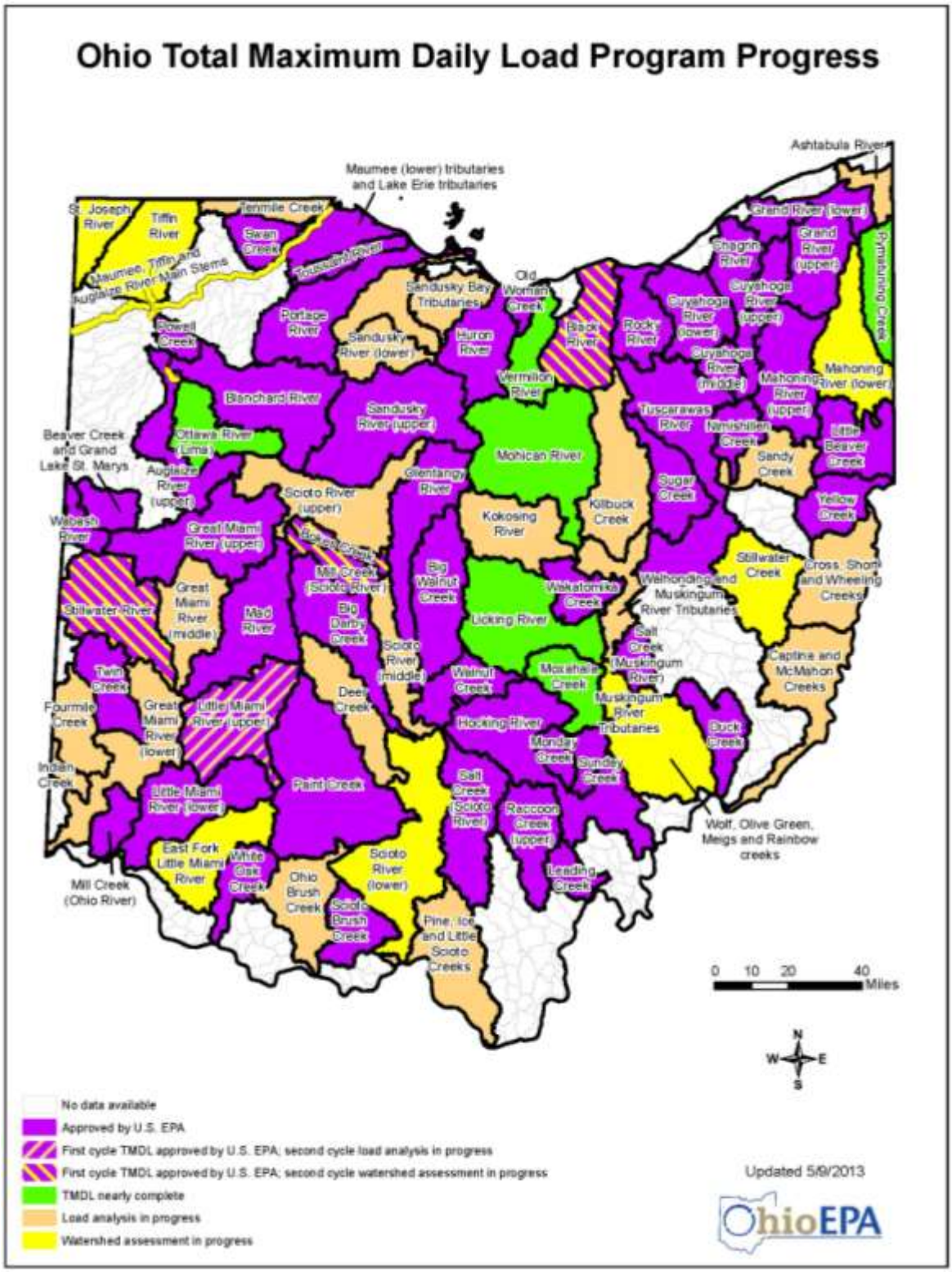
Ohio has completed over 200 nutrient TMDLs in priority watersheds since 2002. This has been accomplished using current narrative water quality standards and implementing guidance for setting the TMDL nutrient target values.

Ohio EPA has been using the results of biological and water quality surveys to identify nutrient impaired waters and to establish Total Maximum Daily Loads (TMDLs) since 2002. A total of 222 nutrient TMDLs have been completed in the six priority river basins listed in Section 3.2. Additional nutrient TMDLs have been completed in other areas of Ohio. Nearly all of these TMDLs establish load reduction goals based upon in-stream target total phosphorus values, with some also including nitrogen values. The in-stream target values were developed by Ohio EPA and are protective of the aquatic life use designations in the watershed[6]. Figure 5 shows the progress in completing TMDL project s. Collectively these past and future efforts will result in load reduction goals for all HUC8 scale watersheds in Ohio. Completed TMDL reports can be accessed online at http://epa.ohio.gov/dsw/tmdl/index.aspx .

Unfortunately TMDL project results cannot be readily aggregated at the major basin or statewide level. Differences in the methods used to generate load reduction goals in different watersheds make it extremely difficult to generate a state-wide nutrient mass balance sheet to calculate the current nutrient loads from point and nonpoint sources. Similarly, it is difficult to calculate and the reductions necessary to achieve standards at the statewide level.

[6] Ohio EPA 1999. Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams Ohio EPA Technical Bulletin MAS/1999-1-1.

Figure 5. TMDL project status as of May 9, 2013.



6.0 Ensure Effectiveness of Point Source Permits

Key message:

Ohio has a strong track record with regard to the identification of waters impaired by nutrients and doing the follow-up work to complete nutrient TMDLs and issuing NPDES permits with phosphorus limits. Further improvements are underway to refine the assessment of nutrient impaired waters and to uniformly implement point source nutrient removal requirements.

The number of NPDES permits with nutrient limits and/or monitoring requirements is reported in Section 3.6. Using existing regulations, such as narrative nutrient criteria and numeric biological criteria linked to aquatic life beneficial uses, the Agency's approach has been to require meaningful reductions in point source loads where aquatic life uses are impaired. By applying knowledge and experience already gained we can retains what has worked and modify procedures. This produces an effective strategy that clarifies how Ohio EPA will work with point sources to reduce nutrient levels to continue to evolve and improve. The objective is to more effectively produce results that work in the NPDES program, restore water quality where impairment exists and maintain Ohio's higher quality waters. Additional consideration must be given to translating the load allocation results for nonpoint sources into more meaningful information with practical applications in in the implementation of nutrient reduction practices.

The program needs one significant change: an improved ability to incorporate the evaluation of downstream impacts of nutrient loadings. Traditionally Ohio EPA's stream survey work is conducted at a watershed level made up of multiple adjacent HUC 12 units. Nutrient TMDLs are produced that meet target levels at the outlet of the combined drainage. Additional consideration may be needed to consistently evaluate whether inland lake nutrient standards will be met for lakes within the study area as well as lakes located downstream, including Lake Erie.

Point Source Nutrient Loading Strategies for Streams and Rivers - Near Field Impacts

Ohio EPA will apply the following guidelines regarding point source NPDES permits and phosphorus limits. These guidelines do not replace regulations or policy, for example 3745-33-06 which regulates discharges to publicly owned lakes or reservoirs and their tributaries.

The first step in the implementation of nutrient removal at point sources is to confirm that one of the following holds true:

- Based on the most recent and comprehensive data available the stream segment is currently impaired or threatened by nutrient enrichment [the Trophic Index Criterion (TIC) is designed to answer this question]; or
- Based on the most reliable forecast of future conditions (modeling of chlorophyll a, dissolved oxygen and projections of biological stream health) the TIC outcome indicates an impaired or threatened stream condition.

Both of these outcomes represent situations where WLA values must be calculated to meet all applicable water quality criteria for protection of beneficial uses. Ohio EPA will continue this practice for

the purpose of preparing approvable TMDLs. There are several other program factors that have bearing on an overall strategy for phasing in more restrictive point source permit limits:

- WLAs in TMDLs can be replaced only by re-doing the TMDL (attaining water quality standards (WQS) does not alleviate WLA in approved TMDL);
- TMDLs (including WLAs) must be calculated to meet the selected nutrient target;
- Permits must be consistent with TMDL WLAs; and
- All facilities must be assigned a load in the WLA, or no discharge of that pollutant is allowed.

In recognition of the preceding factors Ohio EPA intends to phase in water quality based effluent limits for phosphorus derived from the TMDL/WLA calculations. This will be done over a time frame to allow point sources to explore water quality trading or other options. Tables 4 and 5 contain guidelines for implementing initial limits for total phosphorus (TP) for Publicly Owned Treatment Works (POTWs) in conjunction with the longer term requirement to comply with WLA derived water quality-based effluent limits (WQBELs) or alternate standards.

Table 4. Guidelines for assigning initial phosphorus NPDES limits for POTWs discharging 1 MGD or more. If no effluent data available to estimate load, use a concentration of 3 mg/l.

	Condition of Water	**Guidelines for Initial NPDES Permit Content**
Lake Erie Basin	Not impaired for nutrients	Set initial permit limit at 1.0 mg/l at design flow, per long-standing Lake Erie policy
	Impaired for nutrients	Set initial permit limit at the lower of 1.0 mg/l at design flow or existing permitted load (with trading option, habitat fixes). Include permit language requiring POTW to minimize discharge of phosphorus by optimizing existing treatment facility.
Ohio River Basin	Not impaired for nutrients	Include existing effluent load in WLA in TMDL. No phosphorus permit limit; monitoring per guidance.
	Impaired for nutrients	Set initial permit limit at the lower of 1.0 mg/l at design flow or existing permitted load (with trading option, habitat fixes). Include permit language requiring POTW to minimize discharge of phosphorus by optimizing existing treatment facility.

Table 5. Guidelines for assigning initial phosphorus NPDES limits for POTWs discharging less than 1 MGD. Actions are the same in the Lake Erie and Ohio River basins. If no effluent data available to estimate load, use a concentration of 3 mg/l.

Design Flow (MGD)	Condition of Water	WLA and NPDES Permit Content
1.0 to 0.15	Not impaired for nutrients	Include existing effluent load in WLA in TMDL. No phosphorus permit limit; monitoring per guidance
	Impaired for nutrients (phosphorus); this source is predominant contributor to impairment	**Set initial permit limit at 1.0 mg/l** and design flow
	Impaired for nutrients (phosphorus); this source is one of multiple contributors to impairment	**Set initial permit limit at 1.0 mg/l** and design flow if phosphorus limits will result in a significant improvement in biological assemblages. Monitoring per guidance if no limit.
0.15 To 0.025	Not impaired for nutrients	Include existing effluent load in WLA in TMDL. No phosphorus permit limit; monitoring per guidance
	Impaired for nutrients; this source is predominant contributor to impairment	**Set initial permit limit at 1.0 mg/l** and design flow
	Impaired for nutrients; this source is one of multiple contributors to impairment	Include existing effluent load in WLA in TMDL. No phosphorus permit limit; monitoring per guidance
Less than 0.025	**Any impairment situation**	Include existing effluent load in WLA in TMDL. No phosphorus permit limit; monitoring per guidance

Point Source Nutrient Strategies for Lakes and Other Far Field Sinks

All significant contributors to the annual pollutant loading generated within a watershed need to be evaluated with respect to the impact of that load on downstream aquatic environments that function as nutrient sinks. The amount of nutrients flowing into a lake environment, as well as the amount cycling in and out of bottom sediments, will determine the lake's trophic condition. To truly understand lake nutrient loadings, all inputs (tributaries and direct discharges to the lake) need to be monitored throughout the year, reflecting a wide variety of flow conditions. Watershed models, such as the

Generalized Watershed Loading Function (GWLF) or the Soil Water Assessment Tool (SWAT) are being evaluated for use in conjunction with lake models such as BATHTUB and CE-QUALW2 to develop appropriate tools for addressing lake impairments.

7.0 Nonpoint Source Nutrient Reduction Strategies

Key message:

Today's nutrient water quality problems won't be solved simply by implementing more of the most commonly preferred conservation practices as in the past. This section promotes targeted nutrient reduction projects in relatively small watersheds to showcase new methods and innovative approaches for the restoration of beneficial uses for Ohio's lakes and streams by substantially reducing nutrient loss form Ohio's landscape.

There is mounting evidence that simply increasing the application of the same practices will not address the current water quality problems in Ohio, especially those that stem from too many nutrients entering our streams and lakes. The condition of aquatic life in 48 percent of Ohio's small and medium sized rivers is impaired by high nutrient levels during summer base flow conditions. During runoff events, peak nutrient loads are flushed through small streams and rivers and reach lake ecosystems. These excessive nutrient levels result in harmful algae blooms (HABs), increased water treatment costs and in some cases create public health hazards. Data indicate that the amount of dissolved phosphorus reaching Lake Erie has increased even though loadings of total phosphorus have remained constant. **This new information requires major adjustments to the way we think about agricultural conservation practices in rural areas and storm water management practices in urban and suburban areas of Ohio.** This includes educational activities such as the "4R Initiative" on soil nutrient stewardship. The 4Rs include the right source of nutrients, in the right rate, at the right time and the right place (more information is available on line at http://www.nutrientstewardship.com/). Promoting the "4R's" nutrient stewardship program is an important first step in re-thinking current farming practices. We also need to identify and implement more effective practices for reducing the rate of storm water runoff from both agricultural and urban landscapes. There should be a strong focus on reducing the delivery mechanisms to nearby and distant surface water bodies such as streams and lakes.

The traditional practices by which nutrients are applied to the land surface need to be reconsidered. New and innovative practices for draining excess water from rural and urban landscapes also need to be developed with a focus on nutrient delivery mechanisms to nearby and distant surface water bodies. This section presents a framework for addressing NPS pollution designed to result in measureable improvements in water quality. Details on how the approaches and practices are implemented at either a statewide or watershed level are yet to be determined. Section 5 summarizes several significant efforts already underway to engage agricultural producers and other stakeholders in controlling NPS runoff.

7.1 Nonpoint Source Strategic Framework

There are two basic strategies that can be employed to address Ohio's nonpoint source (NPS) nutrient loading issues. The first is to reduce nutrient loadings to Ohio's rivers and streams. This strategy employs practices and actions that are designed to reduce the "sources" of nutrients and include such things as reducing the application of crop nutrients or improving the timing and placement of manure and commercial fertilizers. A second often overlooked strategy includes actions that are designed to physically improve a streams capacity to assimilate the nutrient load that is already in the waters.

Decades of channelization, damming of rivers and other alterations to a stream's natural flow have severely decreased the natural assimilation of nutrients.

These dual strategies serve as an important foundation for dealing with Ohio's nonpoint sources of nutrients. Ohio EPA has made further recommendations to specifically address two general nonpoint sources of excessive nutrients: those coming from agricultural sources and those from urban and residential storm water runoff. Ohio's approach identifies various sources of nutrient pollutants, deploys multiple strategies and specific practices designed to reduce the delivery of excess nutrients to surface and ground waters.

Nonpoint Source Nutrient Reduction and Assimilation Strategies

Listed below are Ohio's broad strategies for addressing nonpoint sources of nutrients. Selected recommendations made by the Directors' Agricultural Nutrient and Water Quality Working Group (DANWQWG 2012) are included.

Upland Management Strategies (see section 3.5.3 for specific practices)

1. Increase whole farm conservation planning so that water quality related resource concerns are prioritized for agricultural best management practice (BMP) selection and implementation.
2. Erosion and sediment loss are significant contributors of nutrients to surface waters. Further reduction of erosion is needed to help achieve improvements in water quality.
3. *Develop and follow nutrient management plans for all farms using voluntary participation and incentives* (DANWQWG 2012).
4. Manure and fertilizer application should be limited to only those levels that meet the agronomic need of the crops in the rotation.
5. *Develop and implement a statewide, standardized soil testing program. Select a pilot watershed by August 2012. Couple results with development of nutrient management plans* (DANWQWG 2012).
6. Increase the retirement of marginal and highly vulnerable lands.

Livestock Management Strategies (see section 3.5.3 for specific practices)

1. Improve manure management practices.
2. Effectively manage runoff in livestock production areas.
3. Improve grazing practices.
4. Reduce phosphorus content in animal feed.

Drainage Water Management Strategies (see section 3.5.3 for specific practices)

1. Reduce the rate and amount of runoff.
2. Increase retention and treatment of field runoff.

Riparian Management Strategies (see section 3.5.3 for specific practices)

1. Increase riparian wetland retention areas.
2. Increase riparian forested acres.
3. Establish "no-plow" zones in riparian areas.

Improve Urban Storm Water Management Practices (see section 3.5.4 for specific practices)

Ground Water Protection Measures

Nutrient management strategies must ensure that we do not shift nutrient loads from surface water to ground water. The diversion of agricultural runoff from agricultural fields can occur in areas of Karst geologic formations and in rare circumstances through water wells. Ohio needs to be vigilant while implementing nutrient reduction strategies that we are not simply moving the issue from surface to ground water resources. Ground water supplies are critical resources that must be protected from nutrients and other contaminants.

Investigate fertilizer regulations (applicator licensing)

The Ohio Department of Agriculture (ODA) Pesticide & Fertilizer Regulation section currently issues licenses to pesticide applicators that require continuing education credits every three years. A similar certification and licensing program should be developed by ODA to license commercial and private fertilizer applicators with program curriculum focusing on the 4R concept, and other best management practices which may emerge. To assist in the timely implementation of such a program, one option to consider is the adoption of an online component of the training module in the near term. Additionally, the current Pesticide Applicators License curriculum should be amended to require a basic block of instruction on the 4R stewardship model before the creation of a Fertilizer Certification Program (DANWQWG 2012).

Gather more and better data on fertilizer sales

The Ohio Department of Agriculture's statutory authority should be amended to require the collection of more specific data on where fertilizer sales are made. Currently, fertilizer retailers in Ohio must report to ODA the tonnage (amount) of fertilizer that is sold, but there is no requirement to provide information about where that fertilizer's last distribution point is located. Fertilizer retailers (as the last point of sale) that sell fertilizer to a farmer should report not only how much fertilizer has been sold, but also the location to which the fertilizer has been sold (either the county or zip code). In addition, ODA should require fertilizer retailers to provide an additional report on the amount and location (county or zip code) of fertilizer that the retailer is applying on behalf of the farmer. The purpose of this change would be to provide more data for research and to guide future policy making decisions (DANWQWG, March 2012).

Outreach and education

The initial focus is on soil stewardship and the principles of 4R nutrient management. A comprehensive communication and outreach effort, coordinated by the Ohio Department of Natural Resources (ODNR) Division of Soil and Water Resources, is underway to educate agricultural producers on the importance of and methods for nutrient stewardship (DANWQWG 2012).

Re-assess authority of Division of Soil and Water Resources

The Director of ODNR should re-assess the existing authority by which the Division of Soil and Water Resources can issue orders to more aggressively pursue and regulate persons with continued violations in order to discourage habitual bad actors. Additionally, the authority of the ODNR Division of Soil and Water Resources should be clarified to allow the Division to review and approve nutrient management plans when the primary nutrient being applied is manufactured fertilizer.

Chapter 1511 of the Ohio Revised Code should also be amended to include manufactured fertilizer and biosolids in the definition of Nutrient and Agricultural Pollution (as used in ORC 1511.02 and related revised code sections) and to include "sub-surface drainage." These changes would modernize the statutory authority of the Division to more comprehensively regulate nutrient movement into the state's waters (DANWQWG 2012).

7.2 Recommended Management Practices to Prevent Agricultural Nutrient Losses to Surface Waters

Considerable improvements are needed for on-the-ground conservation practices that specifically focus on nutrient reduction and water quality protection and improvement. In addition to traditional goals of reducing erosion, it is becoming apparent that a concerted effort is needed to improve drainage water management. The increased percentage of cropland receiving systematic subsurface drainage is causing significant alterations to the physical integrity and hydrology of Ohio's streams. Management practices that improve a stream's capacity to assimilate existing pollutant loads also are needed to round out a comprehensive strategy for reducing the impact of nutrients running off the agricultural landscape and into Ohio's rivers and streams, and ultimately our lakes. The following practices are recommended as the most promising means of reducing the loss of nutrients from agricultural land use to surface waters. These recommendations are based in part on a ranking of the effectiveness of Ohio-USDA NRCS practices (Ohio EPA 2010)[7].

7.2.1 Upland Management Practices

1. ***Increase whole farm conservation planning so that water quality related resource concerns are prioritized for agricultural best management practices (BMP) selection and implementation***.

   Whole farm conservation planning and conformance with such plans has given way to more specialized plans such as nutrient management plans and/or grazing plans. This change occurred over a period of time and was the result of shifting priorities and changes in state and federal funding for agricultural cost-share practices and programs. Operations need to be evaluated holistically so all necessary BMPs are installed and working together to maximize nutrient reductions. Critical locations where nutrient losses occur must be identified so appropriate conservation measures can be implemented. It is also important for appropriate conservation practices to be designed and installed according to a whole farm conservation plan.

2. ***Erosion and sediment loss are significant contributors of nutrients to surface waters. Further reducing erosion is a critical goal in achieving measurable improvements in water quality.***
   A variety of best management practices have been designed and deployed for the control of erosion and to prevent the loss of soils from the agricultural landscape. Specific practices that are recommended for achieving measurable soil erosion reduction include:

   Grassed Waterways (412) – Provided that they are strategically located in areas where ephemeral gully erosion is occurring, grassed waterways may be effective practices to reduce erosion and sediment loss, thereby reducing the input of nutrients into streams. It is imperative that design and

[7] Analysis of Effectiveness of Ohio NRCS Practice Standards in Addressing Five Leading Causes of Water Quality Impairment available online at http://epa.ohio.gov/portals/35/lakeerie/ptaskforce/BMP_Effectiveness_Final030110.pdf

installation of these practices be done to enable their full nutrient reduction capabilities to be achieved.

Treatment Filter Areas (Per Ohio-NRCS FOTG Standard 393) – For decades, the conservation practice of choice for many agricultural producers as well as conservation professionals has been the "grass filter strip". However, the common "filter strip" practice of placing 30 to 100 foot wide bands of grass vegetation parallel to streams and water-ways has historically been installed under the Farm Service Agency Conservation Reserve Program (CRP) and Conservation Reserve Enhancement Program (CREP) per the NRCS Conservation Cover standard 327. As a result, these projects should not be equated with filter areas designed under NRCS 393 specifications. Conservation Cover installations plant grass only, and Treatment Filter Areas are designed and installed in areas where flow concentrates so that runoff can successfully be dispersed and passively treated as it flows into and passes through these filter areas. Conservation professionals agree that in Ohio almost all commonly installed filter strips have not been designed to consider contributing watershed size and slope, and do not disperse concentrated flow through the entirety of the installed filter area---according to the FOTG 393 standard (memorandum from Ohio State Farm Services Agency, State Executive Director, January 18, 2010). *There is opportunity to improve the effectiveness of the streamside conservation cover (filter strips) by installing appropriately designed treatment and water filtration areas where field runoff occurs.*

Cover Crops (340) – In 2008 the use of cover crops as a tool for managing excessive nutrients began a resurgence and has been increasing throughout the agricultural community. Ohio's nonpoint source nutrient reduction strategy encourages the planting of cover crops postharvest as part of long term conservation crop rotations. However, Ohio EPA does not advocate *the use of cover crops solely to promote the ability of livestock producers to spread manure on ground where nutrient levels exceed agronomic crop need, or when the ground is frozen or snow-covered.* Cover crops provide multiple benefits including:

- Increasing the soil's organic matter to improve soil moisture holding capacity.
- Maintaining a living root in the soil most of the year to uptake excess nutrients.
- Adding crop diversity to improve microbial communities.
- More effective assimilation of applied nutrients in soils.

Reduced Tillage Practices – There are a variety of farming systems and USDA-NRCS eligible practices that significantly reduce soil tillage including No Till/Strip Tillage (329) and Mulch Tillage (345). These and other conservation tillage practices are effective tools for reducing soil erosion and will aid in retaining nutrients on harvested farm ground. Strip tillage practices that disturb only 10-15 percent of the soil surface will allow for improved fertilizer efficiency and less soil erosion compared to traditional tillage practices. Further water quality benefits may be realized when reduced tillage practices are designed to incorporate fertilizer and manure into the soil at the time of application, or shortly thereafter. New technologies are being designed with this goal in mind.

Install Retention Devices to Interrupt Surface Runoff and Drainage Tile Discharges – Current agricultural drainage practices are designed to remove water quickly from fields through both surface and subsurface drains. Drainage has resulted in significant alterations to the hydrology and physical integrity of streams throughout Ohio. Any effort to reduce erosion and improve water quality requires a commitment to better manage the flow of this nutrient rich surface runoff and drainage water. Retention structures such as passive treatment wetlands, storm water ponds and/or other effective water retention structures are encouraged. Several USDA-NRCS eligible best management practices that meet this need include:

- Structure for Water Control (587)

- Sediment Basin (500)
- Water and Sediment Control Basin (638)
- Constructed Wetland (656)
- Wetland Restoration (657)
- Wetlands Creation (658)
- Wetland Enhancement (659)
- Drainage Water Management (554)
- Blind Inlet (included within Underground Outlet, 620)
- Enable implementation of 2-stage ditch and self-formed channels (overwide) in channelized systems where appropriate.

Manure and fertilizer application should be limited to only those levels that meet the agronomic need of the crops in the rotation

The application of manure from livestock operations should be focused on utilizing the manure as a nutrient substitute to commercial fertilizer. The total nutrient application rate should closely match the forecasted agronomic need for the planned crop rotation. Nutrients applied at high rates, applied to vulnerable or sensitive locations, or applied shortly before rainfall or snowmelt may result in very high levels of dissolved phosphorus moving from the field application site and into nearby waterways. This can result in fish kills and contribute to algae blooms in both streams and lakes. Nutrient inputs, whether from manure or commercial fertilizer sources should be applied using the following guidelines.

- Develop and implement a nutrient management plan.
- Manage nutrients using the "4Rs" (right source, right time, right place and right rate)
- Use precision nutrient management practices and methods.
- Only apply manure and fertilizer based upon up-to-date soil sample tests.
- Do not apply phosphorus if soil test levels are already greater than agronomic need (for example, greater than 40 parts per million (ppm) for corn and soybeans and 50 ppm for wheat and alfalfa.
- Reduce broadcast application of commercial fertilizer unless it will be readily incorporated into the soil or is applied on a growing crop.
- Where possible, use modern minimally invasive equipment to incorporate manure.

3. Increase the retirement of marginal and highly vulnerable lands

Challenging economic conditions in recent years have contributed to continuing production on lands that are marginally productive and/or highly vulnerable riparian areas. With increased risk to flooding and high levels of nutrient loss the retirement of these vulnerable lands should become a priority. Land rental rates and cost-share amounts provided by the United States Department of Agriculture (USDA) either through programs such as the Conservation Reserve Program (CRP), Wetlands Reserve Program (WRP) and others typically are not competitive enough to provide a true incentive for land retirement. These programs and associated land rental rates need to be re-evaluated and updated to reflect levels that encourage and provide meaningful incentive for marginal land retirement to increase. Following are recommendations to increase retirement of marginal lands:

- Enroll agricultural lands that are marginally productive and/or vulnerable to frequent flooding and/or high nutrient losses in CRP, WRP or the Conservation Reserve Enhancement Program (CREP) and retire them from ongoing production.

- Once retired, Environmental Quality Improvement Program (EQIP) and other cost-share programs should be revised to allow these lands to be converted to appropriate hydraulic buffers such as riparian plantings, wetlands and/or drainage retention or filter areas.

7.2.2 Livestock Management Strategies

1. Improve manure management practices

The improper management of livestock manure and continued over-application of manure on soils already saturated with nutrients (especially phosphorus) is a significant challenge in watersheds with a high density of livestock. Soils in some watersheds have soil phosphorus levels that could provide adequate fertility for decades before needing additional phosphorus inputs—yet each year some of these same soils continue to receive manure applications. Effective manure management is critical if we are to see water quality improvements and/or measurable reductions in nutrient loadings to our streams. At a minimum, manure management should be conducted to conform to the following guidelines:

- Apply manure at rates based on agronomic need and as determined by up-to-date soil tests
- Manure application should be based on phosphorus need for subsequent cropping cycle and USDA-NRCS standard
- When appropriate, applied manure should be incorporated into soils as soon as possible to facilitate optimum microbial assimilation into soil
- Manure should not be applied when precipitation is imminent
- Records of all manure applications should be maintained
- Eliminate manure application in critical areas where losses of manure nutrients to surface water are most likely
- Eliminate the application of manure on snow covered and/or frozen ground

Approved USDA-NRCS best management practices when applied to strategic critical areas that may help to improve manure management include:

- Nutrient Management (590)
- Waste Storage Facility (313)
- Waste Treatment Lagoon (359)

2. Effectively manage runoff in livestock production areas

Runoff from livestock feeding areas or other livestock production areas such as feedlots, loafing pads and milking parlors is typically highly nutrient-enriched, often flowing directly into ditches and/or small streams. Runoff management in any areas where large numbers of livestock congregate is extremely important for preventing nutrient loadings to streams and waterways. Managing runoff from livestock congregating areas should be conducted using the following guidelines:

- Clean water should be diverted from contact with accumulations of manure
- Manure and other solids should be scraped regularly and stored under roof
- Runoff flowing from feedlots etc. should be diverted from waterways and handled appropriately (e.g., disposal via land application or treatment via wetland or filter areas)
- Install appropriate storage to manage silage and milk house parlor wastewater
- Eliminate uncovered feeding areas

USDA-NRCS best management practices that may be useful in improving the management of runoff from livestock production areas include:

- Waste Storage Facility (313)
- Heavy Use Area Protection (561)
- Livestock Use Area Protection (757)
- Roof Runoff Structure (558)

3. Improve Grazing Practices

Improperly managed grazing is a source of both erosion and nutrient loading into streams and other waterways. As a growing number of farmers enhance operations by adding livestock the potential for poorly managed grazing to impact water quality increases. Grazing practices should be developed or improved using the following guidelines:

- Develop and implement a prescribed grazing plan that factors in water quality concerns
- Eliminate uncontrolled livestock access to streams and drainage ways
- Maintain areas that receive heavy use and high traffic
- Provide shade and watering sources away from streams

A variety of grazing related best management practices are eligible for cost-share funding under the NRCS-Environmental Quality Improvement Program (EQIP). When these practices are strategically installed in critical areas vulnerable to runoff and nutrient loss, they can be effective. These include:

- Prescribed Grazing (528)
- Heavy Use Area Protection (561)
- Spring Development (574)
- Watering Facility (614)
- Water Well (642)
- Livestock Exclusion Fencing (472)

4. Reduce phosphorus content in animal feed

An emerging tool in influencing the nutrient content in livestock manure is reducing phosphorus content within the feed that animals are provided. The adage “less going in means less coming out” has merit in some applications. Reducing nutrients by adjusting animal feed should consider the following:

- Adjust feed nutrition content to meet herd production, size, age and sex needs
- Reduce nutrient content in feed based upon the Natural Resource Council recommended rates (found in NRC technical notes)
- Measure nutrient percentages in feed and account for increases of phosphorus content in manure generated by animals fed Dry Distillers Grain w/ Solubles
- Incorporate the microbial enzyme phytase into diets

7.2.3 Drainage Water Management Strategies

1. Reduce the rate and amount of runoff

Perhaps the single most important action that can be taken to reduce nutrient loadings and impacts on Ohio streams is to reduce the rate and amount of runoff from agricultural production areas. For decades, grass filter strips (FSA CP-21) have been advocated as important tools to provide a buffering media for sheet flow runoff. Cost-share funding has resulted in the installation of many thousands of acres of these practices. Unfortunately, a very small percentage of CP-21 “filter strips” are designed to disperse and filter runoff from each discreet contributing drainage area. Likewise, there is very little actual filtration of surface runoff from contributing cropland because FSA CP-21 filter strips (designed as conservation cover standard FOTG 327) are mostly bypassed by

concentrated flow runoff. In addition, a significant percentage[8] of the total drainage from farm fields in Ohio is flowing through sub-surface tiles and discharges directly into waterways without ever passing through a filter strip. There is a real need to design and install more effective buffers—filtering areas rather than strips specifically designed to capture, retain or disperse runoff. The challenge is convincing farmers and other landowners that these alternative drainage designs can be installed while still maintaining the overall functionality of the drainage systems. Reducing the rate and amount of runoff will require:

- Designing and installing more effective edge of field buffer areas to retain and/or disperse storm water runoff from fields (E.g., Filter Strips/Areas per NRCS FOTG Standard 393)
- Install water control devices that retain nutrient laden waters in subsurface drain tiles prior to release into streams
- Increase cover crop planting as part of a long-term conservation crop rotation designed to rebuild the soil's organic matter and increase the soil's water holding capacity
- Install drainage water devices on surface and subsurface tile drain outlets
- Enable implementation of 2-stage ditch and self-formed channels (overwide) in channelized systems where appropriate.

Drainage water management practices, also known as controlled drainage are an important emerging set of tools for dealing with field runoff and mitigating the impacts of tile drainage. Several NRCS approved practices that help with drainage water management include:

- Drainage Water Management (554)
- Structure for Water Control (587)
- Filter Strips/Areas (393)
- Wetland Creation (658)
- Discharge Ponds
- Blind Inlet (included within Underground Outlet (620)

2. Increase treatment of field runoff

It is neither practical nor likely that runoff from agricultural fields can be prevented or eliminated. Instead, the installations of practices that increase assimilative treatment of runoff prior to its discharge into streams are encouraged. For example, runoff from a livestock feeding area should be diverted through infiltration areas and/or wetlands so that nutrients can be assimilated via extended detention and/or vegetative uptake. Following are guidelines and recommendations for increasing the treatment of field runoff:

- Direct concentrated field runoff and drainage from livestock feeding areas through wetland and/or infiltration areas
- Enable implementation of 2-stage ditch and self-formed channels (overwide) in channelized systems where appropriate.
- Increase the use of fixed-bed bioreactors containing coarse sand and organic carbon such as tree bark or wood chips
- Increase the use of soil amendments such as alum, gypsum or water treatment residuals to increase the absorption of phosphorus and decrease the amount of phosphorus in runoff.

USDA-NRCS eligible practices that will assist landowners with implementing this recommendation include the following:

[8] An estimate of between 25-75 percent in any given year (personnel communication by N. Fausey, USDA, ARS, Columbus Ohio)

- Wetlands Restoration (657)
- Wetlands Creation (658)
- Filter Strips/Areas (393)
- Organic Bioreactors (NRCS standards are currently being prepared)

7.2.4 Riparian Management Strategies

1. ***Increase riparian wetland retention areas.***
   The buffering capacity of riparian areas has steadily declined as riparian forested and wetland areas have shrunk under increasing pressure to increase production acres. Combined with hydromodification, the alteration of riparian habitat are the two highest magnitude nonpoint causes of aquatic life use impairment in Ohio[9]. Re-establishing, restoring and enhancing existing riparian wetlands to serve as detention areas for tile discharges and other drainage from agricultural fields is critical to reducing the impact of nutrient laden discharge water. Riparian wetland areas are highly effective at assimilating nutrients through infiltration and/or vegetative update. Several USDA programs offer cost-sharing incentives for increasing and/or restoring riparian wetland areas that meet the needs of an effective nutrient reduction strategy.

2. ***Increase riparian forested acres.***
   Like riparian wetland areas, Ohio's riparian forests have been in steady decline as agricultural equipment and production has expanded in size. The capacity for a riparian corridor of at least 120 feet wide (the equivalent of the canopy of **two** mature trees) to store water and assimilate nutrients is considerable. Riparian corridors provide important streamside habitat for wildlife, as well as important shading to the water, thereby reducing algae blooms and water temperatures. Numerous USDA-NRCS based programs such as Conservation Reserve Enhancement Program (CREP); the Conservation Reserve Program (CRP), EQIP and others provide cost-share incentives for the re-establishment and expansion of riparian forests. Program eligible best management practices include:
   - Riparian Forest Buffer (391)
   - Tree/Shrub Establishment (612)
   - Upland Wildlife Habitat Improvement (645)
   - Windbreak/Shelterbelt Establishment (380) and Renovation (650)

3. ***Establish "no-plow" zones in riparian areas.***
   This strategy needs careful consideration because while the approach of protecting stream banks and riparian areas has obvious water quality benefits the concept carries negative images of unwanted "land use control" There are currently many tracts of land where riparian areas are plowed or cultivated up to the stream's edge. The resulting bank slippage, sediment loss and potential nutrient loadings from such poor land management damages the soil and water resources of the State. Educational efforts targeting landowners and conservation incentive packages are needed to aggressively promote the benefits of "no plow zones"—those riparian areas where cultivating and plowing are carefully restricted along waterways. Farmers should strongly consider enrolling all riparian areas into programs such as CRP or CREP where annual rental payments may help offset the loss of income that would come with establishing "no plow zones".

[9] Ohio EPA. Ohio 2012 Integrated Water Quality Monitoring and Assessment Report. Available online at http://epa.ohio.gov/dsw/tmdl/OhioIntegratedReport.aspx

7.3 Recommended Management Practices for Urban and Suburban Nonpoint Nutrient Reductions

Communities face many challenges with respect to storm water infrastructure. In the past, cities have used gray infrastructure to address water resource concerns. Communities face mounting challenges, which include reducing the impact of storm water on combined sewer discharges, water quality issues associated stream bank failures and water quantity issues associated with stream flashiness and flooding. In many cases, continued reliance on aging gray infrastructure will not sufficiently meet the necessary water quality and quantity improvements needed today. As such, the state of Ohio is already embracing emerging "green" infrastructure practices and technologies, and shall continue to do. Following is a strategy Ohio can utilize to help communities statewide realize the social, economic and environmental benefits of improving water quality with environmentally-sustainable green storm water infrastructure and proactive regulatory oversight, education and outreach. Descriptions and concepts provided below in the "Improve Storm Water Management Practices" section are largely borrowed from U.S. EPA's "National Menu of Storm Water Best Management Practices." A more comprehensive listing is provided by U.S. EPA is available online at http://cfpub.epa.gov/npdes/storm water/menuofbmps/index.cfm.

Improve Urban Storm Water Management Practices

1. **Municipal development-innovative site planning storm water BMPs including low impact development (LID) and other green design strategies.**
   Urban development significantly alters the natural features and hydrology of a landscape. Development and redevelopment creates impervious surfaces like concrete sidewalks and asphalt roadways, commercial and residential buildings, and even earth compacted by construction activities. Prevented from soaking into the ground, rainwater runs across parking lots and streets, collecting used motor oil, pesticides, fertilizers and other pollutants.

   In most cities, a complex system of piping usually feeds contaminated storm water flows directly into streams and coastal waters. More recently, storm water control structures (sometimes called Best Management Practices or BMPs) like dry extended detention ponds or wet retention ponds have been installed, most in new development, to intercept storm water on its way to surface waters.

   Historically, the goal of storm water planning has been to prevent localized flooding by moving large amounts of water off-site as quickly as possible. However, experience has shown that traditional storm water management has many limitations.

   Expensive, ever-expanding storm sewer systems strain municipal budgets. Fast moving storm water discharges causes downstream flooding, erode stream banks and contribute to water quality violations. Bacteria and other pathogens carried in storm water contaminate coastal waters, often requiring beach closures. Rainwater diverted or otherwise unable to soak into the soil cannot recharge aquifers. This reduces stream base flows, which can cause streams to dry for extended periods of time. Storm water that collects in detention basins or flows over impervious surfaces is often much warmer than the streams into which it flows. This is a problem because temperature increases of just one or two degrees can stress fish and other aquatic organisms.

   - **Low impact development (LID) –** Like other alternative development strategies, LID seeks to control storm water at its source. Rather than moving storm water off-site though a

conveyance system, the goal of LID is to restore the natural, pre-developed ability of an urban site to absorb storm water.

- **Conservation Easements –** Conservation easements are voluntary agreements that allow individuals or groups to limit the type or amount of development on their property. A conservation easement can cover all or just a portion of a property and can either be permanent or temporary. Easements typically describe the resource they are designed to protect (e.g., agricultural, forest, historic or open space easements), and they explain and mandate the restrictions on the uses of the particular property. Easements can relieve property owners from the burden of managing these areas by shifting responsibility to a private organization (land trust) or government agency better equipped to handle maintenance and monitoring issues. Furthermore, in some cases tax benefits might be realized by property owners who place conservation easements on some or all of their property.

  Conservation easements may indirectly contribute to water quality protection. Land set aside in a permanent conservation easement has a prescribed set of uses or activities that generally restrict future development.

  The location of the land held in a conservation easement may be evaluated to determine its ability to provide water quality benefits. Property along stream corridors and shorelines can act as a vegetated buffer that filters pollutants from storm water runoff. The ability of a conservation easement to function as a stream buffer depends on the width of the easement and in what vegetated state the easement is maintained.

- **Eliminate curbs and gutters –** This practice promotes grass swales as an alternative to curbs and gutters along residential streets. Curbs and gutters are designed to quickly convey runoff from the street to the storm drain and, ultimately, to a local receiving water. Consequently, they provide little or no removal of storm water pollutants. Indeed, curbs often act as traps where deposited pollutants remain until the next storm washes them away. Many communities require curbs and gutters as standard elements of road sections. In fact, many communities discourage the use of grass swales. Revisions to current local road and drainage regulations are needed to promote greater use of grass swales along residential streets.

- **Green Parking –** Green parking refers to several techniques that applied together reduce the contribution of parking lots to total impervious cover. From a storm water perspective, green parking techniques applied in the right combination can dramatically reduce impervious cover and, consequently, reduce the amount of storm water runoff. Green parking lot techniques include: setting maximums for the number of parking lots created; minimizing the dimensions of parking lot spaces; utilizing alternative pavers in overflow parking areas; using bio retention areas to treat storm water; encouraging shared parking; and providing economic incentives for structured parking.

- **Green Roofs –** Green roofs can be effectively used to reduce storm water runoff from commercial, industrial, and residential buildings. In contrast to traditional asphalt or metal roofing, green roofs absorb, store, and later evapotranspire initial precipitation, thereby acting as a storm water management system and reducing overall peak flow discharge to a storm sewer system. Furthermore, conventional roofing can act as a source for numerous toxic pollutants including lead, zinc, pyrene and chrysene (Vane Metre and Mahler, 2003).

Green roofs have the potential to reduce discharge of pollutants such as nitrogen and phosphorous due to soil microbial processes and plant uptake. However, initial studies conflict as to the removal efficiency of nutrients by green roofs, particularly nitrogen. If implemented on a wide scale, green roofs will reduce the volume of storm water entering local waterways resulting in less in-stream scouring, lower water temperatures and better water quality. In urban areas with combined sewer systems, storm water and untreated human and industrial waste are collected in the same pipe. During periods of heavy rainfall and snow melt, these systems can become overwhelmed by the volume of water and overflow into nearby water bodies resulting in combined sewer overflows (CSOs). Since green roofs can reduce the volume of storm water discharged, CSOs can also be reduced, thus preventing the discharge of millions of gallons of sewage into local waterways.

2. Slow down, store and infiltrate runoff from impervious surfaces with municipality oriented BMPs.

Municipal BMPs include those that promote ground infiltration, filtration and/or water storage of runoff for impervious surfaces, such as roofs, streets, parking lots and sidewalks. Many municipalities are starting to see the value of improved green infrastructure. Some traditional and emerging technologies are listed below.

Infiltration

- **Grassed Swales –** In the context of BMPS to improve water quality, the term swale (also known as grassed channel, dry swale, wet swale, bio filter or bio swale) refers to a vegetated, open-channel management practices designed specifically to treat and attenuate storm water runoff for a specified water quality volume. As storm water runoff flows along these channels, it is treated through vegetation slowing the water to allow sedimentation, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Variations of the grassed swale include the grassed channel, dry swale and wet swale. The specific design features and methods of treatment differ in each of these designs, but all are improvements on the traditional drainage ditch. These designs incorporate modified geometry and other features for use of the swale as a treatment and conveyance practice.
- **Infiltration Basin –** An infiltration basin is a shallow impoundment which is designed to infiltrate storm water into the soil. This practice is believed to achieve high pollutant removal efficiencies and can also help recharge the ground water, thus increasing base flow to stream systems. Infiltration basins can be challenging to apply on many sites.
- **Permeable pavers –** Permeable interlocking concrete pavement (PICP) consists of manufactured concrete units that reduce storm water runoff volume, rate and pollutants. The impervious units are designed with small openings within permeable joints. The openings typically comprise 5 percent to 15 percent of the paver surface area and are filled with highly permeable, small-sized aggregates. The joints allow storm water to enter a crushed stone aggregate bedding layer and base that supports the pavers while providing storage and runoff treatment. PICPs are highly attractive, durable, easily repaired, require low maintenance and can withstand heavy vehicle loads.
    - **Porous concrete and porous asphalt –** Pervious concrete, also known as porous, gap-graded or enhanced porosity concrete, is concrete with reduced sand or fines and allows water to drain through it. Pervious concrete over an aggregate storage bed will reduce storm water runoff volume, rate and pollutants. The reduced fines leave stable air pockets in the concrete and a total void space of between 15 and 35 percent, with an average of 20 percent. The void space allows storm water to flow through the concrete and enter a

crushed stone aggregate bedding layer and base that supports the concrete while providing storage and runoff treatment. When properly constructed, pervious concrete is durable, low maintenance and has a low life cycle cost.

Porous asphalt, also known as pervious, permeable, "popcorn" or open-graded asphalt, is standard hot-mix asphalt with reduced sand or fines and allows water to drain through it. Porous asphalt over an aggregate storage bed will reduce storm water runoff volume, rate and pollutants. The reduced fines leave stable air pockets in the asphalt. The interconnected void space allows storm water to flow through the asphalt and enter a crushed stone aggregate bedding layer and base that supports the asphalt while providing storage and runoff treatment. Properly constructed porous asphalt is a durable and cost competitive alternative to conventional asphalt.

Filtration

- **Bio-retention (i.e., rain gardens) –** Bioretention areas, or rain gardens, are landscaping features adapted to provide on-site treatment of storm water runoff. They are commonly located in parking lot islands or within small pockets of residential land uses. Surface runoff is directed into shallow, landscaped depressions. These depressions are designed to incorporate many of the pollutant removal mechanisms that operate in forested ecosystems. During storms, runoff pools at the top layer of mulch and soil in the retention area. Runoff from larger storms is generally diverted to the storm drain system. The remaining runoff filters through the mulch and prepared soil mix. The filtered runoff can be collected in a perforated underdrain and returned to the storm drain system.
- **Filter strips/areas –**Vegetated filter strips (grassed filter strips, filter strips and grassed filters) are vegetated surfaces designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants. Filter strips also provide some infiltration into underlying soils. Filter strips were originally used as an agricultural treatment practice and have more recently evolved into an urban practice. With proper design and maintenance filter strips can provide relatively high pollutant removal. One challenge associated with filter strips, however, is that it is difficult to maintain sheet flow, so unless concentrated flow is properly dispersed through entirety of the strip or area, the practice may be "short circuited" by concentrated flows, receiving little or no treatment. Concentrated flow also contributes to the significant shortfall in effectiveness of the majority of installed agricultural filter strips.

Detention/Retention

- **Dry Detention Ponds –** Dry detention ponds (also known as dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain storm water runoff for some minimum time (for example, 24 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool of water. However, they are often designed with small pools at the inlet and outlet of the basin. They can also be used to provide flood control by including additional flood detention storage.
- **Wet Ponds –** Wet ponds (also known as storm water ponds, wet retention ponds, wet extended detention ponds) are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season). Ponds treat incoming storm water runoff by allowing particles to settle and algae to take up nutrients. As storm water

runoff resides in this pool the primary removal mechanism is settling, and pollutant uptake, particularly of nutrients, also occurs through biological activity in the pond. Traditionally, wet ponds have been widely used as storm water best management practices.

- **Storm water wetlands** (also known as constructed wetlands) **–** Storm water wetlands are structural practices similar to wet ponds that incorporate wetland plants into the design. As storm water runoff flows through the wetland, pollutant removal is achieved through settling and biological uptake within the area. Wetlands are among the most effective storm water practices in terms of pollutant removal. Wetlands additionally offer aesthetic and habitat value. Although natural wetlands can sometimes be used to treat storm water runoff that has been properly pretreated, storm water wetlands are fundamentally different from natural wetland systems. Storm water wetlands are designed specifically for the purpose of treating storm water runoff, and typically have less biodiversity than natural wetlands in terms of both plant and animal life. Several design variations of the storm water wetland exist, each design differing in the relative amounts of shallow water, deep water and dry storage above the wetland.

  A distinction should be made between using a constructed wetland for storm water management and diverting storm water into a natural wetland. Diverting to a natural wetland is not recommended as altering the hydrology of the existing wetland with additional storm water can degrade the resource and result in plant die-off and the destruction of wildlife habitat. In all circumstances, natural wetlands should be protected from the adverse effects of development, including impacts from increased storm water runoff. This is especially important because natural wetlands provide storm water and flood control benefits on a regional scale.

3. Control Erosion from construction sites and barren ground

Exposed and barren ground (especially sloped ground) is especially vulnerable to storm related erosion. Where land is left exposed in the absence effective management practices, one large storm can erode significant amounts of silty, clayey and/or sandy soil into Ohio's waterways. Controlling erosion is most readily done by promoting vigorous growth of rooted vegetation, but temporary controls are sometimes needed to protect from erosion while vegetation is being established. Following is a select listing of BMPs designed to minimize erosion in urban and suburban settings.

- **Sodding –** Sodding is a permanent erosion control practice and involves laying a continuous cover of grass sod on exposed soils. Sodding can stabilize disturbed areas and reduce the velocity of storm water runoff. Sodding can provide immediate vegetative cover for critical areas and stabilize areas that cannot be readily vegetated by seed. It also can stabilize channels or swales that convey concentrated flows and reduce flow velocities.

- **Seeding –** Seeding is used to control runoff and erosion on disturbed areas by establishing perennial vegetative cover from seed. It reduces erosion and sediment loss and provides permanent stabilization. This practice is economical, adaptable to different site conditions, and allows selection of a variety of plant materials.

- **Compost Blanket –** A compost blanket is a layer of loosely applied compost or composted material that is placed on the soil in disturbed areas to control erosion and retain sediment resulting from sheet-flow runoff. It can be used in place of traditional sediment and erosion control tools such as mulch, netting or chemical stabilization. When properly applied, the erosion control compost forms a blanket that completely covers the ground surface. This blanket prevents storm water erosion by (1) presenting a more permeable surface to the oncoming sheet flow, thus facilitating infiltration; (2) filling in small rills and voids to limit channelized flow; and (3) promoting establishment of vegetation on the surface. Composts used in compost blankets are made from a variety of feedstocks, including municipal yard trimmings, food residuals, separated municipal solid waste, biosolids and manure.

  Compost blankets can be placed on any soil surface: rocky, frozen, flat or steep. The method of application and the depth of the compost applied will vary depending upon slope and site conditions. The compost blanket can be vegetated by incorporating seeds into the compost before it is placed on the disturbed area (recommended method) or the seed can be broadcast onto the surface after installation (Faucette and Risse, 2001).

- **Geotextiles –** Geotextiles are porous fabrics also known as filter fabrics, road rugs, synthetic fabrics, construction fabrics or simply fabrics. Geotextiles are manufactured by weaving or bonding fibers that are often made of synthetic materials such as polypropylene, polyester, polyethylene, nylon, polyvinyl chloride, glass and various mixtures of these materials. As a synthetic construction material, geotextiles are used for a variety of purposes such as separators, reinforcement, filtration and drainage, and erosion control (U.S. EPA, 1992). Some geotextiles are made of biodegradable materials such as mulch matting and netting. Mulch mattings are jute or other wood fibers that have been formed into sheets and are more stable than normal mulch. Netting is typically made from jute, wood fiber, plastic, paper or cotton and can be used to hold the mulching and matting to the ground. Netting can also be used alone to stabilize soils while the plants are growing; however, it does not retain moisture or temperature well. Mulch binders (either asphalt or synthetic) are sometimes used instead of netting to hold loose mulches together. Geotextiles can aid in plant growth by holding seeds, fertilizers and topsoil in place. Fabrics come in a wide variety to match the specific needs of the site and are relatively inexpensive for certain applications.

- **Temporary stream crossing –** A temporary steam crossing is used to provide a safe, stable way for construction vehicle traffic to cross a watercourse. Temporary stream crossings provide stream bank stabilization, reduce the risk of damage to the streambed or channel, and minimize sediment loading from construction traffic. The crossing might be a bridge, a culvert or a ford.

  Temporary stream crossings are appropriate where heavy construction equipment must be moved from one side of a stream channel to the other. They can also be used where lighter construction vehicles will cross the stream repeatedly during construction.

  A bridge or culvert is the best choice for most temporary stream crossings because each can support heavy loads. The materials used to construct most bridges and culverts can be salvaged after they are removed. A ford is a shallow area in a stream that can be crossed safely. Fords are appropriate in steep areas where flash flooding might occur and where normal flow is shallow or intermittent across a wide channel. Fords should be used only where stream crossings are expected to be infrequent.

4. Control runoff from construction sites

Runoff controls slow down water in order to reduce erosive force, and to allow for soil to drop out from suspension. Runoff can also be controlled by diverting water away from or around barren soil.

- **Permanent Slope Diversions –** Permanent slope diversions are designed to transport runoff down a slope in a manner that minimizes the potential for erosion. Diversions can be constructed by creating channels laterally across slopes to intercept the down-slope flow of runoff. The channels have a supporting earthen ridge on the bottom sides to reduce slope length, collect storm water runoff and deflect the runoff to outlets that convey it without causing erosion.
- **Earthen Perimeter Control Structures –** These control practices are called temporary diversion dikes, earth dikes and interceptor dikes. No matter what they are called, all earthen perimeter controls are constructed in a similar way with a similar objective **–** to control the velocity and/or route of sediment-laden storm water runoff.
- **Check Dams –** Check dams are relatively small, temporary structures constructed across a swale or channel. They are used to slow the velocity of concentrated water flows, a practice that helps reduce erosion. As storm water runoff flows through the structure, the check dam catches sediment from the channel itself or from the contributing drainage area. However, check dams should not be used as a substitute for other sediment-trapping and erosion-control measures. Check dams are typically constructed out of gravel, rock, sandbags, treated lumber, logs or straw bales. They are most effective when used with other storm water, erosion and sediment-control measures.

5. Control Sediment

Streams can be protected from the detrimental effects of sediment and attached nutrients by slowing down or detaining runoff as well as by filtering sediment from runoff.

- **Filter Berms, Organic Berms, Barriers and Socks –** A gravel or stone filter berm is a temporary ridge made up of loose gravel, stone or crushed rock. Organic berms are often made from compost. Organic material may also be placed in to socks for reduced chance that material washout could occur. Berms and socks slow and filter flow and divert it from an open traffic area. They act as an efficient form of sediment control. One type of filter berm is the continuous berm, a geosynthetic fabric berm that captures sand, rock and soil.

- **Sediment Traps –** Sediment traps are small impoundments that allow sediment to settle out of construction runoff. They are usually installed in a drainage way or other point of discharge from a disturbed area. Temporary diversions can be used to direct runoff to the sediment trap (U.S. EPA, 1993). Sediment traps detain sediments in storm water runoff to protect receiving streams, lakes, drainage systems and the surrounding area. The traps are formed by excavating an area or by placing an earthen embankment across a low area or drainage swale. An outlet or spillway is often constructed using large stones or aggregate to slow the release of runoff (U.S. EPA, 1992).
- **Silt Fence and Straw Bales –** Silt fences are used as temporary perimeter controls around sites where construction activities will disturb the soil. They can also be used around the interior of the site. A silt fence consists of a length of filter fabric stretched between anchoring posts spaced at regular intervals along the site at low or downslope areas. The filter fabric should be entrenched in the ground between the support posts. When installed correctly and inspected frequently, silt fences can be an effective barrier to sediment leaving the site in storm water runoff.

Straw or hay bales have historically been used on construction sites for erosion and sediment control as check dams, inlet protection, outlet protection and perimeter control. Many applications of straw bales for erosion and sediment control are proving ineffective due to the nature of straw bales, inappropriate placement, inadequate installation or a combination of all three factors (Fifeld, 1999). In addition, straw bales are maintenance-intensive and can be expensive to purchase. Because many applications of straw and hay bales have been ineffective, U.S. EPA recommends that other BMP options are carefully considered.

- **Vegetated Buffers –** Vegetated buffers are areas of natural or established vegetation maintained to protect the water quality of neighboring areas. Buffer zones slow storm water runoff, provide an area where runoff can permeate the soil, contribute to ground water recharge and filter sediment. Slowing runoff also helps to prevent soil erosion and stream bank collapse.
- **Storm Drain Inlet Protection –** Storm drain inlet protection measures prevent soil and debris from entering storm drain drop inlets. These measures are usually temporary and are implemented before a site is disturbed.

  There are several types of inlet protection:
  - *Excavation around the perimeter of the drop inlet* **–** Excavating a small area around an inlet creating a settling pool. The pool removes sediments as water is released slowly into the inlet through small holes protected by gravel and filter fabric.
  - *Fabric barriers around inlet entrances* **–** Erecting a barrier made of porous fabric around an inlet creates a shield against sediment while allowing water to flow into the drain. This barrier slows runoff while catching soil and other debris at the drain inlet.
  - *Block and gravel protection* **–** Standard concrete blocks and gravel can be used to form a barrier to sediments that permits water runoff to flow through select blocks laid sideways.
  - Sandbags can also be used to create temporary sediment barriers at inlets. For permanent inlet protection after the surrounding area has been stabilized, sod can be installed. This permanent measure is an aesthetically pleasing way to slow storm water near drop inlet entrances and to remove sediments and other pollutants from runoff.

8.0 Accountability and Verification Measures

Presented here, in order of significance, are the proposed ways in which Ohio will provide accountability and verification of progress in correcting nutrient water pollution:

1. Documenting restoration of beneficial uses in targeted watersheds;
2. Report biennially on the state-wide impact of excessive nutrients on water quality and beneficial use attainment;
3. Calculate annual nutrient loading estimates for the six priority rivers and point sources; and
4. Track basic programmatic efforts of state agencies and key partners.

Key message:

It is important to U.S. EPA and stakeholders in Ohio that there be a defined set of parameters for measuring progress in addressing nutrient water pollution. Ohio's system of assessing the biological health of its rivers and streams provides a good verification measure of overall program success. The periodic reassessment of specific program operations is also important and a framework for measuring progress is outlined in this section and Appendix A.

8.1 Restoration of Beneficial Uses

Ohio EPA conducts biological and water quality surveys on major river basins throughout the state and follows ups with generating Total Maximum Daily Loads (TMDLs) for waters that are impaired. With over thirty years of records the periodic re-visiting of survey areas can yield verified recovery of streams previously impacted by nutrient pollution. The following paragraph summaries key findings on one important river in Ohio.

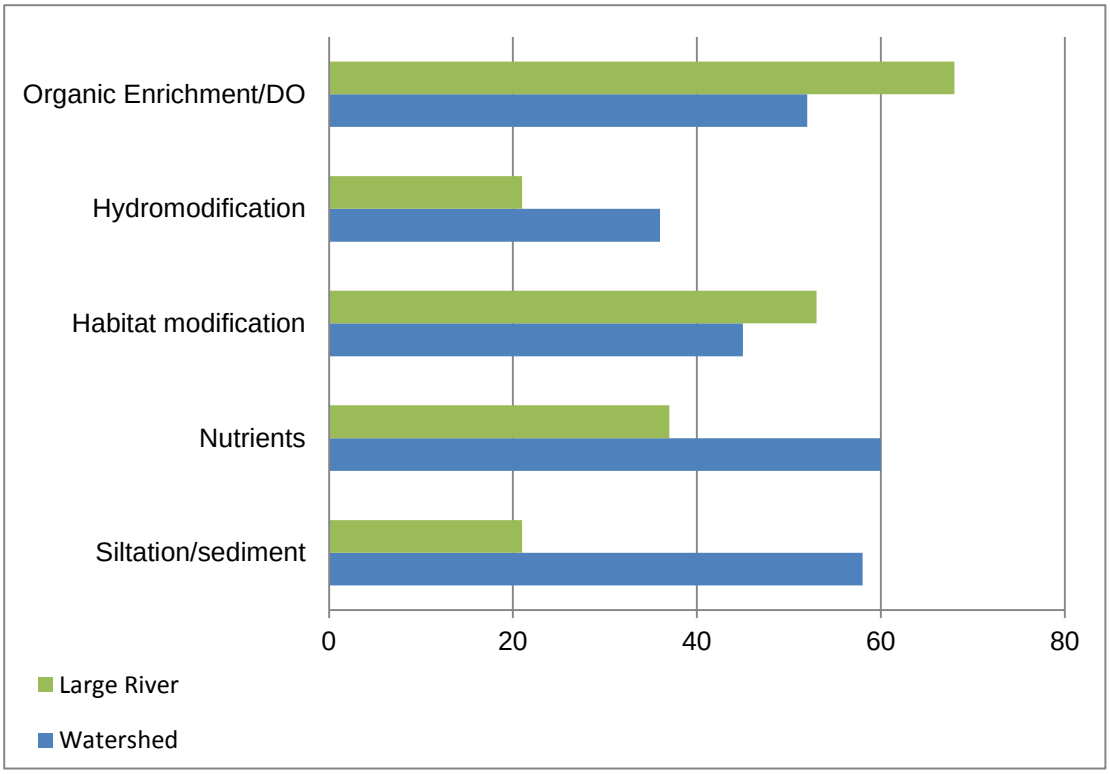
A 1998 survey of the Little Miami River, a National Scenic River and tributary to the Ohio River in southwest Ohio revealed impairment of aquatic life uses. Elevated total phosphorus (median in-stream TP concentration ~ 0.3 mg/l) was a contributing cause and the subsequent TMDL resulted in the imposition of 1 mg/l effluent limits for TP at major wastewater treatment plants. Following plant upgrades and operational changes these facilities are in compliance with their effluent limits. Load duration analysis demonstrated that the new NPDES permit limits had reduced the ambient river TP concentration to a value near the TMDL target by 2008. Follow-up stream survey work in 2011 showed in-stream phosphorus concentrations have been reduced by over 50 percent compared to 1998 levels. Equally important, the biological condition of the river has improved and the Little Miami River is now in full attainment of its Exceptional Warmwater Habitat aquatic life use designation.

8.2 Impairment of Beneficial Uses Attributed to Nutrients

Ohio EPA provides information on the impairment of beneficial uses attributed to impacts cause by excessive nutrients in the biennium *Integrated Report (IR)* submitted in fulfillment of Section 305(b) and Section 303(d) of the CWA.

The Ohio 2012 Integrated Report (Ohio EPA 2012) lists nutrients as one of the leading causes of impairment to rivers and streams in Ohio, with sixty percent of listed waters impaired entirely, or in part, by nutrients (Figure 6). Furthermore, all of near-shore Lake Erie waters are listed as impaired, and though the Integrated Report is not specific with respect to apportioning causes, impairment of assessed sites is due primarily to tributary loadings of nutrients and sediment, exacerbated by continued trophic disruptions caused by the proliferation of exotic species and blue-green algae blooms.

Figure 6. Percent of impaired assessment units that list each major cause.



8.3 Annual Nutrient Loading Estimates

Information on the major sources of phosphorus and nitrogen is important to the evaluation of current programs and future strategic direction on abating nutrient pollution. Knowledge about the relative contributions of phosphorus and nitrogen in terms of the total quantity, the chemical form (dissolved vs. total) and delivery aspect (continuous vs. weather dependent) will be essential in making optimum choices regarding how to manage nutrient reduction efforts. Information on source contributions of nutrient loadings has been broken out by the Lake Erie Basin, Ohio River Basin and, where possible, the 15 smaller priority HUC 8 watersheds.

State-wide Point Source Estimates - Table 6 provides information on the number of public NPDES permits in the Ohio River and Lake Erie watersheds with phosphorus monitoring and limits.

Table 6. Phosphorus monitoring, limits and reported loads from NPDES permitted sources.

Watershed	Number of Sources	
	Lake Erie	Ohio River
Municipal Permits Total **Industrial Permits Total**	729	1,345
Municipal Permits with P Limits **Industrial Permits with P Limits**	105	117
Municipal Permits with P Monitoring **Industrial Permits with P Monitoring**	223	397
% of POTW Permits with P Limits/Monitoring	30.6%	29.5%

Source: Ohio EPA, DSW Permit Retrieval and Analysis Tool. Query conducted 03/02/2011.

As of March 2011 there were 729 Ohio NPDES permitted public wastewater treatment plants (WWTPs) discharging to the Ohio Lake Erie watershed. The majority of the flow from the WWTPs to Lake Erie comes from the 12 major WWTPs with a discharge greater than 15 million gallons per day (MGD). The Ohio Lake Erie Phosphorus Task Force Final Report (April, 2010) cites an estimate of an average load of 585 metric tons per annum (MTA) of total phosphorus from Ohio WWTPs to Lake Erie. A similar estimate of 502 MTA was produced based on WWTP self-monitoring data submitted to Ohio EPA for calendar year 2010.

There are 1,345 Ohio NPDES permitted WWTPs discharging to the Ohio River watershed. The majority of the flow from the WWTPs to the Ohio River comes from the 13 major WWTPs with a discharge greater

than 15 MGD. The estimated loading compiled from a query of 2010 data submitted by WWTPs in the Ohio River basin is 1,744 MTA of total phosphorus.

Wet Weather Events and Combined Sewer Overflows

During dry weather and small wet weather events (i.e., rainfall and snowmelt), combined sewers are designed to transport all flows to a treatment plant. During larger wet weather events the volume of storm water entering the combined sewer system may exceed the capacity of the combined sewers or the treatment plant. When this happens, combined sewers are designed to allow a portion of the untreated combined wastewater to overflow into the nearest ditch, stream, river or lake. Ohio has approximately 1,306 known combined sewer overflow (CSO) outfalls in 86 remaining communities (as of August 2010), ranging from small, rural villages to large metropolitan areas. More information on the program is available online at http://www.epa.ohio.gov/dsw/cso/csoindex.aspx.

There are few direct measurements of total phosphorus or dissolved reactive phosphorus contributions from CSOs. The Ohio Lake Erie Phosphorus Task Force used measurements from some of the Northeast Ohio Regional Sewer District (NEORSD) CSOs and an estimated total CSO annual flow of 10.9 billion gallons as presented in a 2007 report on sewage overflows to Lake Erie (Environment Ohio, 2007). The Task Force report[10] estimated an annual CSO total phosphorus load to Lake Erie of 90.4 (MTA) It is very likely that the estimated annual flow and phosphorus load are on the low end as the estimates were based on an incomplete data set and there is a low level of confidence associated with some data (due to factors such as the use of visual estimations of flow instead of the use of flow monitoring equipment).

It is believed that the estimated annual flow and phosphorus load from Ohio River basin CSO communities is of the same order of magnitude as the annual flow and phosphorus load from Lake Erie basin CSO communities. An estimated total annual CSO flow of 5.9 billion gallons to the Ohio River was obtained for calendar year 2010 from an analysis of NPDES permit Discharge Monitoring Report (DMR) data (Ohio EPA Permit Retrieval and Analysis Tool). However, like the estimate provided in the Environment Ohio Report, the calculations were done on an incomplete data set and there is a low level of confidence associated with some data. Therefore, it is believed that the estimate likely underestimates the CSO flow to the Ohio River. Additionally, CSO flows vary from year to year depending on the frequency and severity of storm events. Nevertheless, using the Lake Erie Phosphorus Task Force estimate of the annual CSO total phosphorus load to Lake Erie as a baseline provides an estimated phosphorus load of 49 MTA to the Ohio River in calendar year 2010.

A more recent Ohio EPA analysis completed in 2012 focused on annual loads produced in three major watersheds each having one or more CSO communities compared to total downstream (ambient) load. Two Lake Erie watersheds – Sandusky River and Cuyahoga River – and one Ohio River Watershed – Great Miami River – were studied. The Sandusky system is primarily agricultural land use (78 percent of total area), the Cuyahoga system is primarily urban (40 percent of total area), and while the Great Miami River is a mixture of both urban and agricultural land use (65 percent agricultural, 17 percent urban). CSO communities with a (d) succeeding their name are downstream of ambient load monitoring and their respective loads will be shown for comparative purposes. CSO communities considered include, for Cuyahoga watershed – Akron, NEORSD (d); for Sandusky watershed – Tiffin, Bucyrus (d); and for Great Miami River watershed – Springfield, Middletown (d).

[10] Ohio Lake Erie Phosphorus Task Force Final Report, April 2010.
http://epa.ohio.gov/portals/35/lakeerie/ptaskforce/Task_Force_Final_Report_April_2010.pdf

To determine CSO nutrient loadings, concentrations were estimated for both total phosphorus (P) and total nitrogen (N). An average total P concentration of 2.19 mg/L was observed by NEORSD at end-of-pipe field observations in the 1990s. In this analysis, a conservative estimate of 5 mg/L total P was made. Total N concentration provided in Metcalf and Eddy (2003) and U.S. EPA CSO "Reports to Congress" (2001; 2004) suggests a midpoint of 10 mg/L. However, a value of 17 mg/L was employed here as a worse-case scenario. A second factor supporting a worse-case scenario is that in-stream processing is ignored. All nutrients leaving the end-of-pipe, whether waste-water effluent or CSO discharge, does not degrade or become assimilated before reaching the downstream ambient comparison point.

The other part of the CSO load is volumetric flow rate (typically measured as billion gallons per year). Flow rates were taken from individual CSO long-term control plans within which a facility's "typical year of discharge" is calculated. "Typical discharges" are modeling estimates based on a long record of rainfall depth and intensity, and number of storms per year.

A comparison of urban loads (both wastewater effluent and CSO discharge) is made to downstream ambient loads for total P (Figure 7) and total N (Figure 8) averaged over the period 2006-2011. The latter were determined from US Geological Survey flow records and National Center for Water Quality Research ambient chemistry monitoring for nutrients. Wastewater effluent loads were extracted from discharge monitoring reports provided by each facility and officially reported to Ohio EPA. For the Sandusky and Great Miami watersheds, both total P and total N loads from urban point sources (WWTP and CSO) represent a small fraction of the total annual load measured at the gage. Only in the urban Cuyahoga watershed does urban point source own 37 (total P) and 63 (total N) percent of the load.

Figure 7. Comparison of total phosphorus annual loads (in metric tons per annum) between downstream ambient loads measured at the gage and loads from CSO dischargers and WWTP effluent for each of three watersheds. Loads represent an annual average over calendar years 2006-2011.

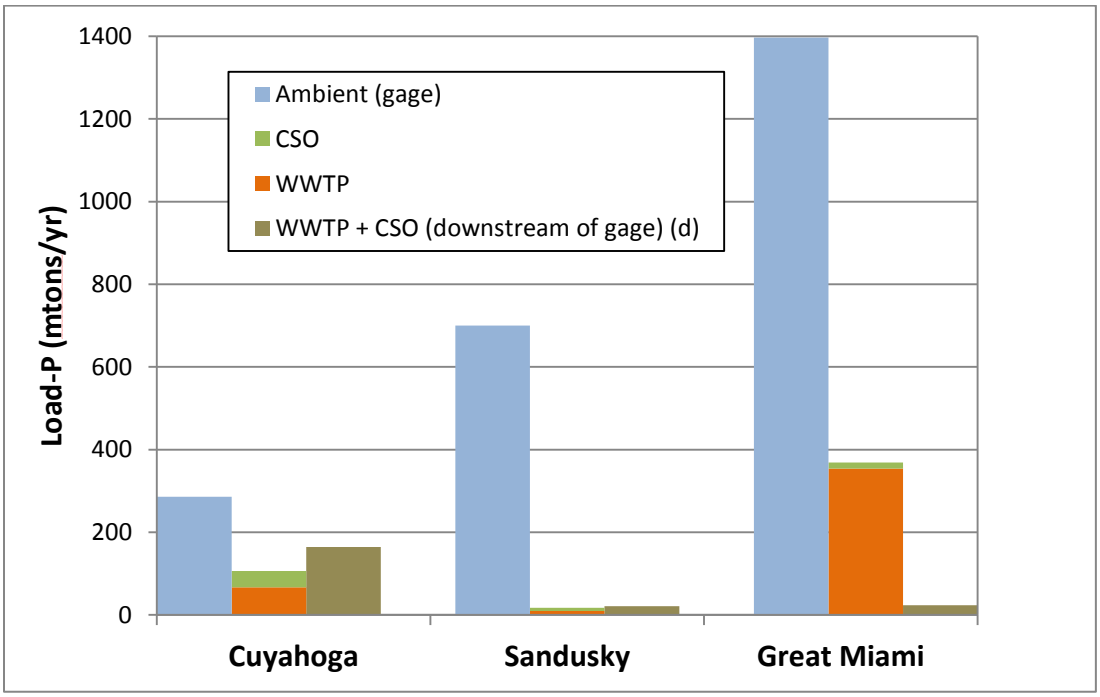
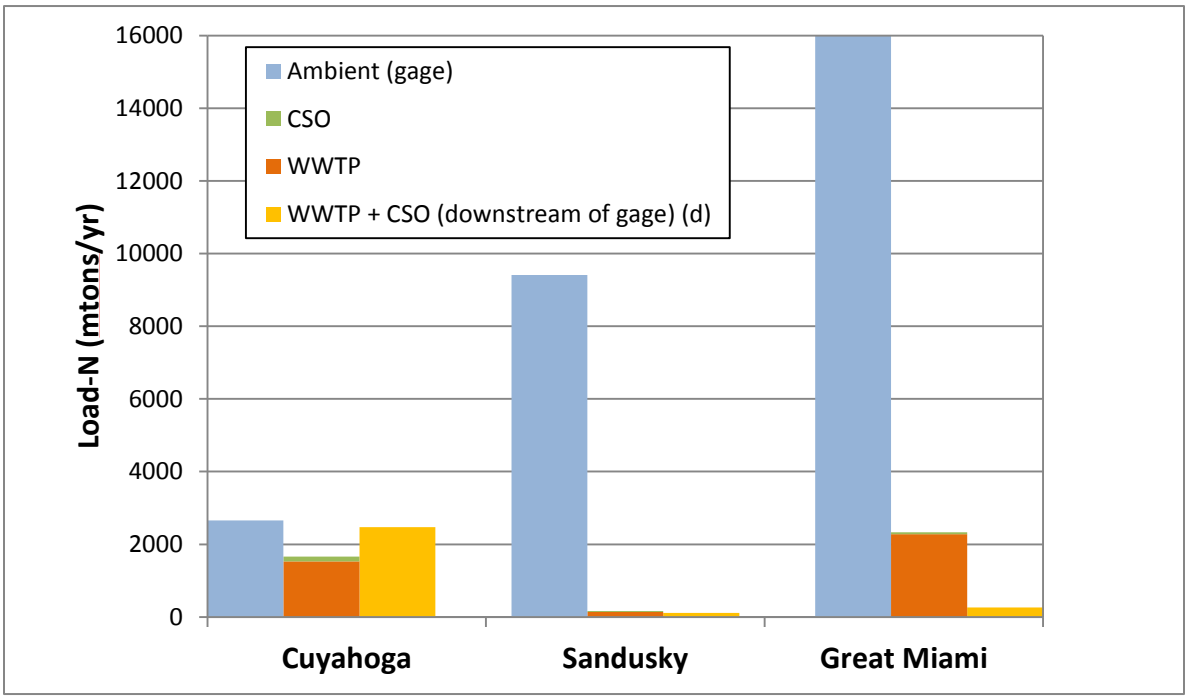


Figure 8. Comparison of total N annual loads (in metric tons per annum) between downstream ambient loads measured at the gage and loads from CSO dischargers and WWTP effluent for each of three watersheds. Loads represent an annual average over calendar years 2006-2011.



Source and Loading Estimates for Priority HUC8 Watershed – Under this strategy Ohio EPA will annually compile nutrient source estimates and loading data for the 15 priority HUC8 watersheds. Point source load estimates are calculated from NPDES permit monthly operating data. Data reported here are average values for a five year period (2006-2011). Source estimates for nutrients in livestock manure are derived from county level livestock census numbers. Ohio intends to develop an improved data-base on commercial fertilizer sales and usage and this data may be reported in the future. Only a fraction of manure and commercial fertilizer nutrients actually migrate and reach surface waters. The size of the resulting load to downstream waters will depend upon whether or not there is widespread adoption of effective best management practices. Compiling this data will help direct where comprehensive manure and nutrient management plans could be prioritized. Currently available Information on source contributions of total phosphorus and total nitrogen are shown on Tables 7 and 8.

Table 7. Reported amounts of total phosphorus (TP) discharged by point sources in the 15 priority HUC8 watersheds.

Drainage Basin / Major River	HUC 8 ID numbers	Watersheds	Point Source TP Load (avg kg/d) (CY 2006-2011)
Lake Erie Basin (288 priority HUC 12 units)			
Maumee River	04100003 04100004 04100005 04100006 04100007 04100008 04100009	St Joseph St Marys Upper Maumee Tiffin Auglaize Blanchard Lower Maumee Entire Maumee	81.6 13.8 3.9 15.2 66.3 22.9 310.7 514.4
Sandusky River	04100011	Sandusky	76.7
Cuyahoga River	04110002	Cuyahoga	267.1
Ohio River Basin (382 priority HUC 12 units)			
Great Miami River (GMR)	05080001 05080002	Upper GMR Lower GMR	519.3 894.9
Scioto River	05060001 05060002 05060003	Upper Scioto Lower Scioto Paint	1202.6 126.6 80.9
Wabash River	05120101	Upper Wabash	26.0

Table 8. Reported amounts of total nitrogen (TN) discharged by point sources. Currently insufficient data is available to estimate the TN content of commercial fertilizer applied and manure generated by livestock in the 15 priority HUC8 watersheds.

Drainage Basin / Major River	HUC 8 ID numbers	Watersheds	Point Source TN Load (kg/d)
Lake Erie Basin (288 priority HUC 12 units)			
Maumee River	04100003 04100004 04100005 04100006 04100007 04100008 04100009	St Joseph St Marys Upper Maumee Tiffin Auglaize Blanchard Lower Maumee Entire Maumee	119.9 126.3 8.7 250.9 717.2 93.8 6077.1 7393.9
Sandusky River	04100011	Sandusky	1099.9
Cuyahoga River	04110002	Cuyahoga	8136.2
Ohio River Basin (382 priority HUC 12 units)			
Great Miami River (GMR)	05080001 05080002	Upper GMR Lower GMR	2987.8 5898.4
Scioto River	05060001 05060002 05060003	Upper Scioto Lower Scioto Paint	8319.4 1008.4 1116.4
Wabash River	05120101	Upper Wabash	

The point source loads and loads exported from selected HUC8 watersheds reflect nutrients that enter surface waters and are transported from the watershed to downstream systems. The exported load estimates reported in Table 9 are average values for a five year period (2006-2011) and for calendar year 2012.

Table 9. Watershed loading estimates from published sources for 15 priority HUC8 watersheds. The exported load of total phosphorus (TP) is measured at the location of the USGS Nation Center for Water Quality Research sampling station and is often located upstream of drainage basin outlet.

Drainage Basin / Major River	HUC 8 ID numbers	Watersheds	Exported Load TP (avg kg/km^2/d) (CY 2006-2011)	Exported Load TP (avg kg/d) (CY 2006-2011)	Exported Load TP (avg kg/d) (WY 2012)
Lake Erie Basin (288 priority HUC 12 units)					
Maumee River	04100003 04100004 04100005 04100006 04100007 04100008 04100009	St Joseph St Marys Upper Maumee Tiffin Auglaize Blanchard Lower Maumee Entire Maumee	0.424	6945.4	5752.8
Sandusky River	04100011	Sandusky	0.542	1759.7	1552.2
Cuyahoga River	04110002	Cuyahoga	0.408	747.9	436.6
Ohio River Basin (382 priority HUC 12 units)					
Great Miami River (GMR)	05080001 05080002	Upper GMR Lower GMR	0.518	3,602.6	2,555.7
Scioto River	05060001 05060002 05060003	Upper Scioto Lower Scioto Paint	0.225	2,246.0	2,926.7
Wabash River	05120101	Upper Wabash	Not available	Not available	

8.4 Basic Program Accountability

State Agencies

Each major program area in state government with regulatory or non-regulatory responsibilities aimed at curbing the delivery of nutrients to waters of the state will summarize and track key activities underway or planned for implementation. An initial list of these programs is presented below. Appendix A provides additional information on each program.

- Ohio EPA
  - Urban Area Storm Water
  - 319 Nonpoint Source Program – Watershed and stream restoration projects
  - Surface Water Improvement Fund Grants
  - Total Maximum Daily Load program
  - National Pollutant Discharge Elimination System Permits
  - Combined Sewer Overflow (CSO) Abatement Efforts
  - Concentrated Animal Feeding Operation NPDES Permits
  - Water Quality Trading
  - Water Quality Standards for nutrients

- Ohio Department of Agriculture
  - Design Requirements For Bulk Dry Fertilizer Storage
  - Design Requirements For Bulk Liquid Fertilizer Storage
  - Livestock Environmental Permitting – Permit to Install
  - Livestock Environmental Permitting – Permit to Operate
  - Livestock Environmental Permitting – Certified Livestock Manager

- Lake Erie Commission
  - Lake Erie Protection and Restoration Plan
  - Lake Erie Protection Fund (LEPF) Grant program

- Ohio Department of Natural Resource
  - Conservation Engineering and Technical Assistance
  - Resource Management Program
  - Western Lake Erie Nutrient Reduction Program
  - Stream Restoration and Morphology
  - Watershed Action Plan State Endorsement
  - Watershed Coordinator Grant Program
  - Coastal Nonpoint Source Pollution Control Program

Federal Agencies, Universities and Non-Governmental Organizations

Effective implementation of the Ohio Nutrient Reduction Strategy, especially aspects involving nonpoint sources, will also involve the efforts of federal agencies, universities, private business and non-governmental organizations. We have collected information about some of these efforts and will partner with these outside entities to periodically report on progress and results. See Appendix A for more information about the listed programs and selected non-governmental efforts.

- Federal Agencies
- Universities
    - Education, Demonstration and Research in Nutrient Utilization
    - Increasing NMP Expertise in Blanchard Watershed
    - Evaluating/Updating the Ohio Phosphorus (P) Risk Index Using Field-Scale, Edge-of-Field Monitoring Data
- Non-Governmental Partnering Organizations
    - The Nature Conservancy
    - Environmental Defense Fund

9.0 Public Reporting

Key message:

Ohio EPA will use its biannual *Integrated Report* to report on the implementation of activities carried out under the *ONRS.*

Appendix A provides the outline of the program activities to reviewed and reported on in the *Integrated Report*. Annual loads estimates for the six priority river basins will be compiled and included in the *Integrated Report.* Tables 9 and 10 will be updated in the 2014 *Integrated Report*. Nutrient loading data for the Wabash/Grand Lake Saint Marys watershed will be included when monitoring stations are operating.

The Section 303(d) portion of the *Integrated Report* is distributed for public review and comment. Concurrent with this public outreach effort Ohio EPA will separately solicit input regarding how to improve implementation of nutrient reduction efforts, suggestions to accelerate cost effective nitrogen (N) and phosphorus (P) load reductions and ways to strengthen collaborative local, county, state and federal partnerships.

10.0 Nutrient Water Quality Criteria

Federal and State Water Quality Standard Framework

Under the Clean Water Act states must adopt Water Quality Standards (WQS) that meet minimum program content requirements. The principle requirements are:

- include to adopt standards that promote the "fishable/swimmable" goals of the Act;
- to identify beneficial uses for each body of water;
- to have criteria to protect those uses; and,
- to have an Antidegradation policy that prevents unnecessary lowering of water quality and that protects all existing water body uses.

Key message:

Ohio EPA has developed and continues to update a general work plan for the development of state water quality standard criteria for nutrients. The work has emphasized the development of Ohio-specific criteria for streams, rivers and inland lakes. Data collection and analysis has been completed for all areas except larger rivers (those with over one thousand square miles of drainage area). In March 2013 the Ohio EPA initiated Early Stakeholder Outreach regarding the adoption of nutrient standards.

U.S. EPA publishes national water quality criteria recommendations. States may adopt these national criteria or develop their own technically defensible criteria. Over the past decade U.S. EPA has consistently urged states to adopt criteria for nutrients. Ohio and 43 other states have established long term WQS program work plans that outline the steps being taken to develop and adopt water quality criteria for nutrients.

Current Nutrient Standards

Ohio's current water quality criteria addressing the problems caused by nutrient enrichment are presented in Appendix B. A nitrate standard of 10 mg/l has been in effect since the 1970s to protect all public drinking water withdrawal locations. A narrative standard for the protection against adverse aesthetic conditions and harm to aquatic life was also put in place in the 1970s. In 1999 Ohio EPA published an implementation mechanism that translates the narrative standard into target phosphorus and nitrogen concentrations that are protective of aquatic life (Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams Ohio EPA Technical Bulletin MAS/1999-1-1). TMDLs prepared by Ohio EPA have used these target nutrient values on water impaired by nutrient enrichment for the past 12 years.

Draft Standards

For Streams and Rivers

Ohio EPA has studied over one hundred stream locations to develop empirical relationships between nutrient concentrations [total phosphorus (TP) and dissolved inorganic nitrogen (DIN)], chlorophyll a produced by benthic algae, dissolved oxygen and overall biological community health (Ohio's existing biological criteria). A multi-metric scoring system has been developed that aggregates results from separate evaluations of primary productivity, biological health and in-stream nutrient concentrations. The resulting output is a multi-metric scoring system referred to as the Trophic Index Criterion (TIC). The TIC provides an integration of "stressor" variables such as nitrogen and phosphorus concentrations that

potentially cause stream degradation with "response" data collected through measurements of biologically important stream attributes.

The conceptual approach is summarized on the attached flow chart. If advanced through the administrative rulemaking process the TIC would be adopted in Ohio's WQS regulations as the criterion to protect the stream and river aquatic life use designations from adverse impacts of cultural eutrophication. Where the TIC indicates that aquatic life uses of a stream are either impaired or threatened due to cultural eutrophication, nutrients would be managed to restore ambient nutrient concentrations to levels below the use-appropriate targets derived from the relationships observed in the Ohio field data. Tentative target values are shown on the flow chart (Figure 9).

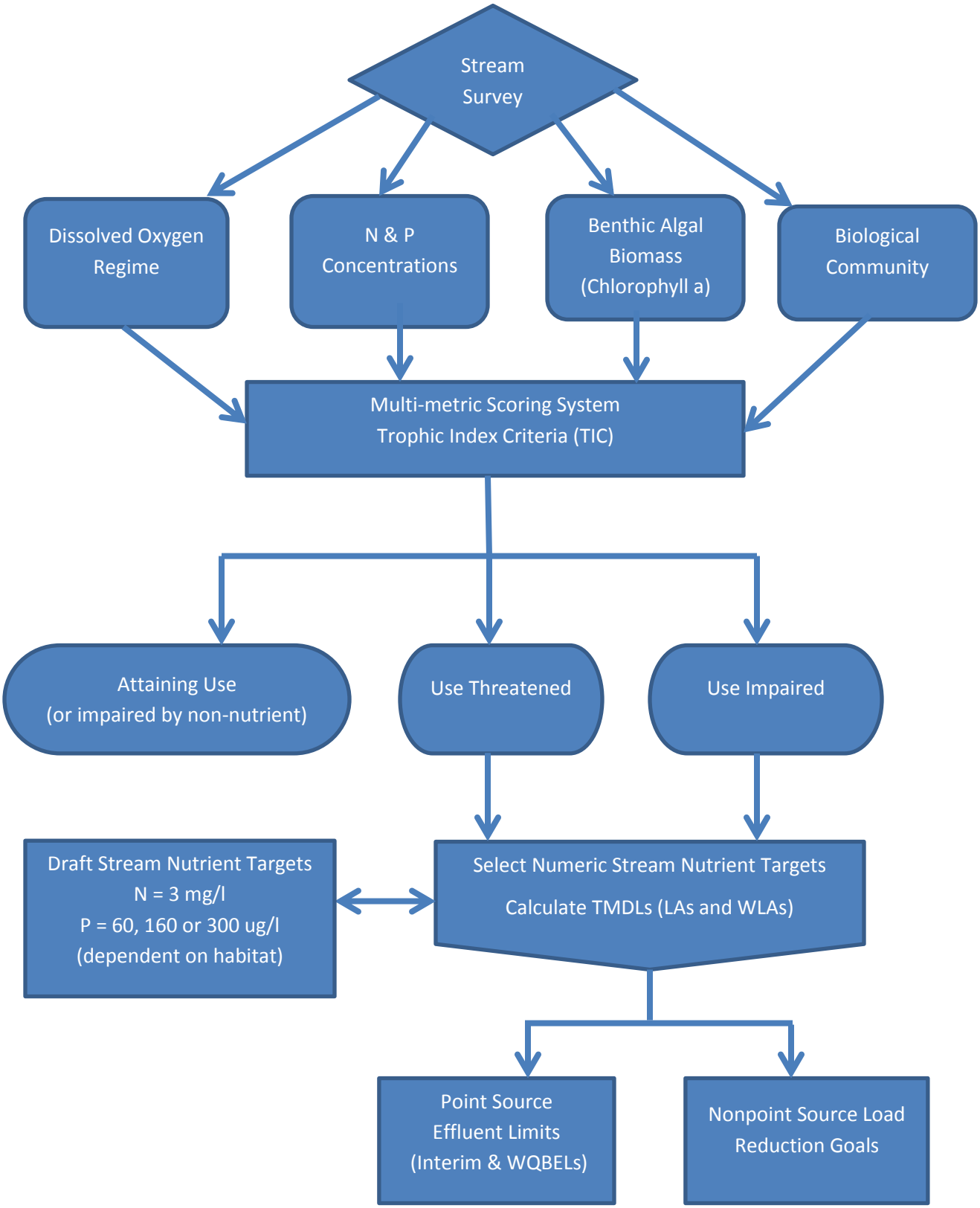
For Inland Lakes

Ohio EPA used the regional reference approach to develop criteria for inland lakes and released these draft standards for interested party review in 2008. Criteria for chlorophyll a, secchi disk transparency, total phosphorus and total nitrogen where developed and stratified where possible by lake type and ecoregion. Ohio EPA is currently re-calibrating the regional reference approach criteria calculations using additional data collected in the past 4 years.

Water Quality Standard Rule Adoption Process

Although the schedule of rule adoption has been delayed a number of times the Division of Surface Water took the first step in the administrative process in March 2013. A fact sheet describing this Early Stakeholder Outreach is attached as Appendix C. Subsequent rule making steps (draft, proposed and final rules) may follow later 2013 and conclude in 2014. More information is available online at http://epa.ohio.gov/dsw/dswrules/nutrientcriteria.aspx.

Figure 9. Conceptual design of the Trophic Index Criterion



List of Appendices

Appendix A

Ohio Nutrient Management Program Descriptions and Tracking Measures

Contents

Part 1

Part 1 of this appendix summarizes programs under the direction of state agencies that are components of the Ohio's overall Nutrient Reduction Strategy. The work of federal agencies and partnering non-governmental organizations are described in Part 2.

Ohio EPA

Urban Area Storm Water (Industrial, Construction and Municipal Storm Water Programs)

Year: Ongoing since 1990

Organizations: Ohio EPA, U.S. EPA, regulated municipalities and businesses

Description: Urban storm water runoff washes chemical contaminants, including nutrients, from relatively impervious hard surfaces and delivers these pollutants via catchments, ditches and pipes to nearby waterways. In the early years of the Clean Water Act (CWA) this urban storm water runoff was considered nonpoint source pollution and was not subject to permitting. That changed in 1987 when Congress amended the CWA to require the U.S. EPA to establish phased NPDES requirements for storm water discharges. Although there are no explicit requirements regarding nutrient reduction several aspects of the program requirements indirectly act to reduce the delivery of nutrients to surface waters.

NPDES storm water program summary information is provided below.

- Phase I, 1990 – The program begins covering certain industrial facilities and larger Municipal Separate Storm Sewer Systems (MS4s)
- Phase II, 1999 – Revised industrial coverage, added construction sites and smaller MS4s
- Storm Water Pollution Prevention Plan (SWP3) and No Exposure Certifications provide the means to limit the movement of pollutants, including nutrients, from permitted sites into surface waters Special construction site storm water general permits issued for sensitive watersheds provide the means to address unique water quality problems (issued for the Big Darby Creek and Olentangy River watersheds)

Table 1: Number of permits issued through Ohio's Industrial Storm Water Program

Ohio's Industrial Storm Water Program		
	# of Facilities under permit	Applicability
Industrial Storm Water General Permit	2,918	Statewide
No Exposure Certification	2,408	

Table 2: Total Storm Water General Permits Issued for construction activities, 2003-2010

Total Construction General Permits Issued		
Year	# Issued	Applicability
2003	2,150	Statewide
2004	2,540	
2005	2,571	
2006	2,623	
2007	1,627	
2008	1,504	
2009	1,240	
2010	1,405	

Table 3: Total number of Municipal Separate Storm Sewer System communities in Ohio

Ohio's Regulated MS4s			
	Permitting Mechanism	**# of MS4s under permit**	**Applicability**
Phase I	NPDES Individual Permits	4	Statewide Currently, 8.8% of Ohio land area regulated (see map)
Phase II	NPDES General Permits	524	

Figure 1: Municipal Separate Storm Sewer System areas in Ohio.

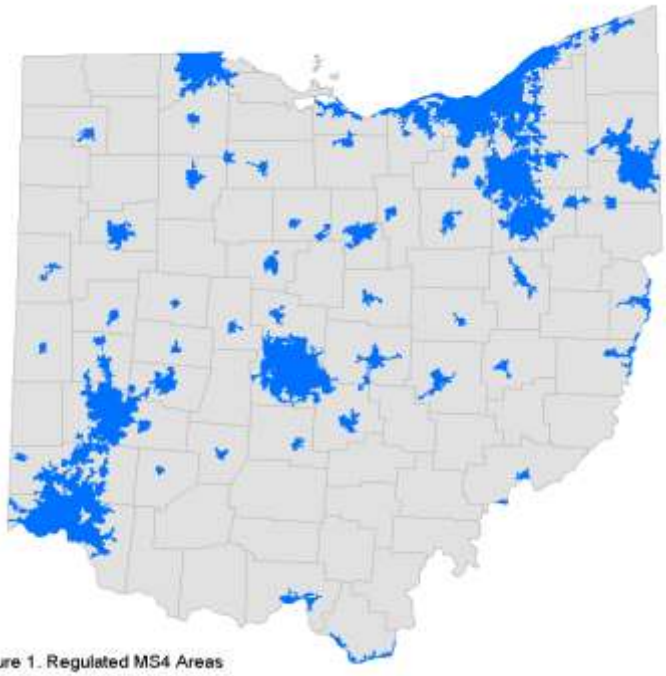


Figure 1. Regulated MS4 Areas

Tracking Measures: Ohio EPA conducts inspections for storm water permitted facilities to ensure compliance with program requirements. Ohio EPA will track the number of inspections conducted on an annual basis compared to these program targets:

- Construction storm water sites – 1,800
- Industrial storm water permit sites – 300
- MS4 storm water sites – 40

319 Nonpoint Source Program – Watershed and stream restoration projects

Year: Ongoing

Organizations: Ohio EPA, U.S. EPA and the following entities eligible to apply for and receive grant funding awarded under Section 319(h) of the Clean Water Act:

- Local municipalities, counties and townships
- County and municipal park districts
- Soil & water conservation districts
- 501(c)(3) nonprofit conservation organizations with land management responsibilities
- Watershed groups with local government sponsorship
- State agencies with land management responsibilities, local and state governmental

Description: Section 319(h) grant funding is targeted to Ohio waters where nonpoint source pollution is a significant cause of aquatic life use impairments. Projects that eliminate such impairments and/or restore impaired waters will score higher in the review process and receive more favorable consideration than general nonpoint source pollution prevention projects. Projects identified in completed Total Maximum Daily Load (TMDL) reports and State-endorsed watershed plans that eliminate impairments and/or restore impaired waters receive higher consideration than projects submitted from other watersheds.

Eligible Projects – Water quality improvement and nonpoint source management projects eligible for funding under Section 319(h) are limited to:

- Stream restoration and re-naturalization using natural channel methodology
- Riparian restoration using green methodology
- Wetland restoration
- Innovative storm water demonstration projects
- Highly targeted (HUC12 scale) agricultural best management demonstration projects
- Inland lake management and restoration

Tracking Measures: Ohio EPA conducts project-appropriate environmental monitoring for all grant-funded sub-grant projects using a dedicated crew from the Division of Surface Water's Ecological Assessment Section or by a contract provider. *No grant funds are used by applicants for water quality monitoring activities.*

Surface Water Improvement Fund grants

Year: Ongoing since 2010

Organizations: Ohio EPA and the following entities eligible to apply for and receive grant funding from the Surface Water Improvement Fund:

- Local municipalities, counties and townships
- Park districts
- Soil & water conservation districts
- 501(c)(3) nonprofit conservation groups with land managing responsibilities
- Watershed groups (with local government sponsorship)

Description: The Surface Water Improvement Fund (SWIF) was created in 2008 and authorizes Ohio EPA to provide grant funding to eligible applicants. SWIF has also been used as leverage for additional grant funds from the Great Lake Restoration Initiative program. Program has been administered since Fiscal Year 2010 and included focus areas as follows: statewide, Cuyahoga County, and Lucas County.

SWIF grants are targeted to waters where nonpoint source pollution is a significant cause of aquatic life use impairments. Projects that eliminate such impairments and/or that restore impaired waters will score significantly higher in the review process and receive more favorable consideration.

Grants awarded under the SWIF will be done so following a competitive process. Projects demonstrating the following at the time of application will receive more favorable consideration during the review process:

- A readiness to proceed.
- Site-specific information or a specifically defined area of focus.
- Appropriate "rights-of-entry" and/or landowner authorization to work on the site
- Consistency with an approved Total Maximum Daily Load (TMDL), endorsed watershed action plan and/or an approved Remedial Action Plan (RAP).
- Evidence that successful completion will result in the elimination of impairments, restoration of natural hydrologic conditions, reduction and/or passive treatment of storm water runoff and/or improvement of riparian or in-stream habitat conditions.
- Allowable, appropriate and reasonable project costs.
- Sponsors with the appropriate authority to complete the proposed project.

In addition, the Ohio EPA's director may elect to award SWIF funds for other projects when doing so may result in the elimination of impairments and/or advancement of nonpoint source management capacity.

Grant Terms and Requirements – SWIF grants will be awarded for a two-year period. Successful applicants will be required to execute a formal grant agreement with Ohio EPA and projects must be completed within the two-year grant year period. *Projects that are "shovel-ready" receive higher consideration.*

Eligible Projects – Water quality improvement projects eligible for SWIF grant funding include:

- Innovative storm water management projects
- Stream restoration and re-naturalization
- Riparian restoration and protection
- Wetland restoration and protection

Tracking Measures: Ohio EPA conducts project-appropriate environmental monitoring for all grant funded sub-grant projects using a dedicated crew from the Division of Surface Water's Ecological Assessment Section or by a contractor. No grant funds are used by applicants for water quality monitoring activities.

Total Maximum Daily Load (TMDL) Program

Year: Ongoing since 1998

Organizations: Ohio EPA, U.S. EPA, regulated municipalities and businesses, local watershed interests,

Description: The Total Maximum Daily Load (TMDL) program, established under Section 303(d) of the Clean Water Act (33 U.S.C. 1313), focuses on identifying and restoring polluted rivers, streams, lakes and other surface water bodies. A TMDL is a written, quantitative assessment of water quality problems in a water body and contributing sources of pollution. It specifies the amount a pollutant needs to be reduced to meet water quality standards (WQS), allocates pollutant load reductions and recommends actions needed to restore a water body.

By integrating programs and aligning resources, Ohio is using TMDLs to develop watershed-specific prescriptions to improve impaired waters. Ohio enhances the basic federal TMDL requirements to increase the chances that real, measurable improvements in Ohio's water resources will result. The process begins with an in-depth watershed assessment (within the Agency's "five-year monitoring strategy") to obtain recent data for analysis of problems and discussion of alternatives. Then implementation actions are identified as part of the TMDL with follow-through in permitting and incentive programs such as 319 and loan funds. Finally, the process tries to involve others – citizens, landowners, officials, natural resource professionals – so that the best, most workable actions are identified. Because of this integration and enhancement, Ohio's TMDL process can be viewed simply as problem solving: investigate the problem, decide on a solution, implement the solution and check back to make sure the solution worked.

The watershed assessments reveal the current status of waters and the causes and sources of problems. Mathematical models are used to assess sources, develop linkages between sources and indicator response, and assist in the allocation process. Loading models predict pollutant movement from land surfaces to water bodies. Models of receiving streams simulate the in-stream concentration of a parameter based on the in-stream fate and transport processes that occur and on pollutant loadings. Loading models can predict what the pollutant load would be based on a particular control action. Receiving water models can take this input and determine if the target is met in the water body. Together they address the question of whether or not a particular restoration plan will result in attainment of the target (e.g., water quality standard).

Tracking Measures: TMDLs must meet approval standards developed by U.S. EPA. The state must complete TMDLs within eight years of listing a waterbody as impaired. TMDLs must provide for public review and comment. TMDLs are active in about 90 percent of Ohio's watershed units. By the end of 2012, 52 TMDL projects had been approved by U.S. EPA and about 30 additional TMDLs are currently

being developed. Nearly all involved nutrients directly or indirectly. All completed TMDLs are available on Ohio EPA's TMDL web page at http://www.epa.ohio.gov/dsw/tmdl/index.aspx.

National Pollutant Discharge Elimination System Permits

Year: Ongoing

Organizations: Ohio EPA

Description: Ohio EPA requires a National Pollutant Discharge Elimination System (NPDES) permit for all facilities discharging pollutants from a point source to a surface water of the state. NPDES permits regulate wastewater discharges by limiting the quantities of pollutants in the discharge and establishing monitoring requirements and other conditions in accordance with Ohio's Water Quality Standards (WQS) and Federal Regulations.

Individual NPDES permits are based on an individual analysis of a discharge and are unique to each facility. The discharge limitations specified in the NPDES permit may be technology-based effluent limits applicable to categories of industries or public facilities. Permits may also utilize water quality based effluent limits (WBQELs) that are necessary whenever technology-based limits cannot achieve the desired in-stream water quality conditions set by the State's WQS. There are currently no nationally promulgated technology limits for total phosphorus and nitrogen.

Total Maximum Daily Load (TMDL) reports identify the load reductions and other actions that are necessary to meet in stream numeric targets to attain applicable water quality standards. Nutrient limits are incorporated into NPDES permits in accordance with TMDL recommendations in accordance with Section 303(d) of the Clean Water Act (U.S. EPA, 2012).

In addition to the limit recommendations of a TMDL, provisions for establishing phosphorous permit limits for publicly owned treatment works (POTWs) in the Lake Erie Basin and statewide are established in Ohio Administrative Code 3745-33-06. The number of Ohio public and semi-public treatment facilities with NPDES permit monitoring requirements or permit limits is shown in

Table4

Table.

Table 4. Ohio Public and Semi-Public Treatment Facilities with Nutrient Monitoring Requirements and Limits

Nutrients	Facilities with Monitoring	Facilities with Limits
Nitrogen	1966	1767
Phosphorus	778	225

Several technologies exist which can facilitate the removal of nutrients to very low levels. As state and federal cost-share assistance for wastewater infrastructure dries up, it is expected that significant rate increases would be passed on to ratepayers to pay for the upgraded technology needed to comply with more stringent nutrient limits. To help communities manage these costs, the Agency writes permits that

provide time for systematic reductions in nutrient discharges, compliance options, reassessment opportunities and potential adjustments to the implementation plans.

Tracking Measures: NPDES permits require facilities to submit self-monitoring facility discharge data to the Ohio EPA using the Discharge Monitoring Report (DMR). In the future, the DMR data can be used to keep track of the number of permits with nutrients limits, the percentage of total POTW effluent design flow in Ohio subject to nutrient limits and the number of POTWs in compliance with the NPDES nutrient limits.

References

U.S. EPA. 2012. Overview of Impaired Waters and Total Maximum Daily Loads Program. Accessed at http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/intro.cfm

Combined Sewer Overflow Abatement Efforts

Year: Ongoing

Organizations: Ohio EPA, U.S. EPA

Description: The National Combined Sewer Overflow (CSO) Policy was enacted by the U.S. EPA in 1994 and made part of Clean Water Act in 2000. It established a national framework to control CSO discharges through the NPDES permit program. The policy applies to the 89 CSO communities statewide.

In the early 20th century combined sewers were built to collect sanitary and industrial wastewater, as well as storm water runoff, and transport the combined wastewater to wastewater treatment facilities. During dry weather and small wet weather events, combined sewers are designed to transport all flows to a treatment plant. During larger wet weather events the volume of storm water entering the combined sewer system may exceed the capacity of the combined sewers or the treatment plant.

Under these conditions, combined sewers are designed to allow a portion of the untreated combined wastewater to overflow into the nearest ditch, stream, river or lake. This prevents the rupturing of pipes, backing up of sewage into basements, and/or flooding of streets. The locations where these discharges of untreated combined wastewater occur, as well as the discharge events themselves, are known as combined sewer overflows (CSOs). CSO locations are unique to each system. CSOs may contain a number of pollutants including nutrients.

Ohio EPA implements CSO controls through provisions included in NPDES permits and by using judicial orders and consent agreements when appropriate. The CSO outfall locations and receiving water bodies are identified in the NPDES permit along with monitoring and reporting requirements for the outfalls. The NPDES permit requires communities to implement best management practices, the nine minimum controls, to minimize the impacts of CSOs.

Ohio's NPDES permits have required communities to develop Long Term Control Plans (LTCPs). In many communities, these LTCPs are huge undertakings with investments of millions and sometimes billions of

dollars to address CSO issues through any combination of sewer separation, storage (tunnels, tanks or basins), treatment plant upgrades, and high rate or auxiliary treatment.

Implementation of an approved LTCP is addressed through a compliance schedule with fixed-date milestones. These schedules may be included either in the NPDES permit or in a judicial order. After the projects of the LTCP have been completed, post-construction monitoring requirements are also incorporated into the NPDES permit to verify that the goals of the LTCP have been met.

Tracking Measures: Conditions of the LTCP are incorporated into the NPDES permit with specific milestone dates and requirements to notify Ohio EPA of achieving those milestones. The LTCP is also evaluated during CSO inspections dedicated to evaluating the community progress towards implementing the LTCP, the success of the LTCP projects, the implementation of the nine minimum control measures and any anticipated revisions or updates to the LTCP. LTCP conditions in a judicial order are tracked by the corresponding legal authority.

Table 5 shows the number of CSO communities by calendar year that have completed construction of all of the required control projects in their LTCP.

Table 5. Projected number of CSO communities that have or will have completed construction of all of the projects in their approved long term control plan.

Projection Year	Projected # of CSO Communities with a Complete LTCP
2012	15
2015	29
2018	41
2021	50
2024	50
2027	63
2030	89

In 2010, U.S. EPA modified their goal for the Water Safe for Swimming Measure, which seeks to address the water quality and human health impacts of CSOs. The goal includes incorporating an implementation schedule of approved projects into an appropriate enforceable mechanism, including a permit or enforcement order, with specific dates and milestones for 86 percent of the nation's CSO communities by the end of September 2011. As of January 2013, 89 percent of Ohio's CSO communities meet this definition.

Concentrated Animal Feeding Operation NPDES Permits

Year: Ongoing since 2001

Organizations: *Ohio EPA, ODA, ODNR, SWCDs, Livestock Industry trade associations and producers*

Description: Ohio EPA has permit delegation authority for the NPDES program, including discharges from concentrated animal feeding operations (defined as point sources in the Clean Water Act). All large animal feeding operations, and medium animal feeding operations with a direct discharge from the production area, are defined as concentrated animal feeding operations. A discharge of pollutants to waters of the state from a Concentrated Animal Feeding Operation (CAFO) is only allowable if it is covered by an NPDES permit. These operations generate manure, litter and process wastewater, which can contain pollutants like nitrogen, phosphorus and bacteria. If CAFO operators do not manage these materials properly, they could release pollutants into the environment through spills, overflows or runoff. These releases, in turn, might pollute surface waters and threaten the health of people and animals.

NPDES permits contain specific requirements for CAFO operations, including requirements for the production area (where animals are confined and where wastes and raw materials are stored) and land application area (land under the control of the CAFO where manure or wastewater is spread). In general, the permit requirements include the following:

- The CAFO may not discharge pollutants, except under certain circumstances.
- The CAFO must develop and implement a manure management plan that specifies best management practices for manure and wastewater handling and disposal which complies with the NPDES permit.
- The CAFO must conduct inspections, perform monitoring and keep records.
- The CAFO must submit an annual report to Ohio EPA.
- Parts I, A and VII of the NPDES permit contain many of the technical standards with which the CAFO must comply.

There are approximately 190 large animal feeding operations in Ohio with permits to operate from the Ohio Department of Agriculture. Ohio EPA currently has over 40 active NPDES CAFO permits, with a large majority issued to large operations. When small or medium operations are discovered to have discharges, Ohio EPA coordinates with ODNR and the local SWCD to try to eliminate those discharges, or in the event the discharges cannot be eliminated in a reasonable timeframe, to limit the discharges through an NPDES permit.

Tracking Measures: Ohio EPA is committed to inspecting CAFOs with NPDES permits at least twice in the 5-year permit cycle (approximately 14 inspections statewide per year). Inspections of unpermitted operations are also conducted to ensure there are no discharges, or to respond to discharges or complaints of discharges. These inspections and any resulting notices of violations or enforcement actions are tracked and reported annually.

Water Quality Trading

Year: Ongoing since 2005

Organizations: *Ohio EPA, U.S. EPA, Ohio Department of Natural Resources – Division of Soil and Water Resources, individual Soil and Water Conservation Districts (SWCDs) , Muskingum Watershed Joint Board of SWCD Supervisors, Great Miami Watershed Joint Board of SWCD Supervisors, The Ohio State University Extension (OSU), and the Electric Power Research Institute (EPRI).*

Description: Water quality trading is a voluntary program that allows an NPDES permit holder (a point source credit buyer) to meet its nutrient limits by purchasing credits for nutrient reductions made by another point source discharger or through nonpoint source controls (the credit sellers).

The cost differential between credit buyer (higher nutrient reduction cost) and credit seller (lower cost) provides the economic driver for trading. Achieving water quality benefits in addition to reducing in-stream nutrient levels (for example: increased assimilative capacity, stream bank stabilization, flow moderation) provides the environmental driver for trading.

In 2003, U.S. EPA released its policy on water quality trading, and by 2005, several trading programs were active in Ohio. To provide a regulatory framework for water quality trading, Ohio EPA adopted rules in 2007, OAC 3745-5. Those rules were reviewed, amended and renewed in 2012.

The key point of the rules is that water quality trading must take place under a plan approved by the Ohio EPA Director. In addition to outlining the requirements for an approvable trading plan, the rules address technical aspects of trading such as:

- Prohibitions and restrictions on trading;
- Calculating water quality credits;
- Setting baselines and trading ratios;
- Incorporating trades into NPDES permits; and
- Limiting trading to avoid adverse impacts.

Industries as well as regulators have recognized that in many watersheds agricultural nonpoint sources also can be major contributors to the nitrogen (N) and phosphorus (P) loading in a given stream and that the cost to abate those agricultural loadings is much less expensive than abatement at the regulated point sources. It is under this premise that market-based nutrient trading has been evolving in Ohio since 2005. Currently there are five trading programs active in Ohio (see descriptions below). However, at this time there is little, if any, active trading of credits for NPDES compliance. As more facilities receive NPDES permits with new or lower nutrient limits, the use of trading as a compliance option has the potential to increase, provided there is an approved trading plan in place.

The Great Miami River Pilot Trading Credit Program was initiated in 2005. During the pilot phase the trading program has funded 397 projects that have reduced 360,630 pounds of total phosphorus and 783,814 pounds of total nitrogen. Final evaluation shows that more than 572 tons of nutrients have been removed and the water quality of the Great Miami River has been improved over the project period.

The ODNR-Division of Soil and Water Resources (ODNR-DSWR) staff has played an integral part in the Great Miami River Trading Credit Program. The ODNR-DSWR staff developed the Load Reduction Spreadsheet that is used to evaluate the best management practices (BMPs) used on the landscape to

estimate the nutrient load reduction. ODNR-DSWR has provided training to soil and water conservation professionals in the Great Miami River Watershed on how to use the spreadsheet estimates for the submittal of projects that will qualify for credits in the trading program. ODNR also provides support and guidance to county SWCDs on issues related to management practice implementation and assessment. On an annual basis ODNR-DSWR reviews a portion of the management practices implemented under the trading program and provides a report to Ohio EPA and Miami Conservancy District on the effectiveness of program procedures as well as any recommendations for trading program improvements. ODNR-DSWR also cooperates in response to management practices that fail.

In the last year ODNR-DSWR staff has aided in the development of a 14 SWCD member Joint Board to launch the trading credit program from its pilot phase by assisting in obtaining grant funding, securing a project coordinator, and providing guidance to the joint board.

The **Alpine Cheese Phosphorus Nutrient Trading Plan** provides a lower cost solution for local cheese maker Alpine Cheese to meet its NPDES permit requirements for phosphorus. The effort was collaboration between the generator, the Holmes County SWCD, OSU Extension and ODNR-DSWR. Between 2006 and 2011, the Alpine Trading Program generated 5,867 total nitrogen credits and 7,059 total phosphorus credits. ODNR Division of Soil and Water staff provided assistance on the nutrient load reduction spreadsheet and subsequent revision to add milk house waste as a practice as well as third party verification of BMPs.

The Walnut Creek Nutrient Trading Plan is another effort by Holmes SWCD. This project will assist Holmes County Commissioners with upgrades to the Walnut Creek Wastewater Treatment Plant to meet its NPDES permit requirements. ODNR - Division of Soil and Water staff will provide similar assistance to that on the Alpine Cheese project.

The Muskingum River Watershed Nutrient Trading Program builds on the success of the Alpine Project to implement nutrient trading within the 6 sub-basins of the Muskingum Watershed. In 2010, the 21-member Muskingum Watershed Joint Board was formed with the purpose of shepherding nutrient trading in the watershed and to act as a broker for the trades. The formation of the joint board was facilitated by ODNR-DSWR Program Specialists at the request of SWCD board members. Subsequently, a Technical Advisory Committee of the joint board was created with leadership provided by the ODNR-DSWR Program Specialist and Resource Management Staff. In 2012, the **Tuscarawas Nutrient Trading Plan** was approved by Ohio EPA and will serve as the template for the five remaining plans. Holmes SWCD was entrusted by members of the joint board to facilitate the writing of remaining plans with funds garnered from an Ohio Soil and Water Conservation Commission/ ODNR-DSWR Toolbox grant and matching funds from member SWCDs. ODNR-DSWR staff also provides third party verification for the project to ensure that practices are built, used and maintained for project purposes.

The Electric Power Research Institute (EPRI) Pilot Ohio River Basin Nutrient Trading Project is focused on developing a framework for interstate trading of nutrient credits for electric power generators. In October of 2009, EPRI announced $1.3 million in federal grants from U.S. EPA and the USDA Natural Resources Conservation Service, as well as $700,000 dollars in matching funding from project collaborators. Assisting EPRI in this venture is the American Farmland Trust. In 2012, under the leadership of the ODNR-DSWR, Ohio entered into agreement with EPRI along with Indiana and Kentucky.

Ohio anticipates receiving $81,000 for BMP cost share to producers attaining a 3-state average nutrient reduction of 7,333 pound of nitrogen and 3,666 pounds of phosphorus. EPRI's target areas in Ohio are Mahoning, Columbiana and Jefferson counties. ODNR-DSWR program specialists facilitated participation by the local SWCDs and currently provides project point of contact for both the SWCDs and EPRI. ODNR-DSWR Resource Management Specialist and Engineers provide technical assistance for best management practice development and will act as third party BMP verifiers upon installation.

Tracking Measures:

Approved trading plans are subject to record keeping requirements. File reviews and audits may be conducted as outlined in the trading rules. Each project has its own set of tracking protocols, usually involving a spreadsheet maintained by the project sponsor. Currently, the DSWR is working with the Soil and Water Information System vendor to produce a Water Quality Trading module that will track project details including individual BMP credits by nutrient, project budgeting, and verification inspections as well as generate pre populated producer trading contracts. Launch of the module is expected before June 2013.

If trading activities are not following the approved plan, the Director may either revoke the plan or require submittal of a new trading plan. In addition, trading plans must be renewed every five years. This process includes a review of the program's environmental and economic effectiveness. For tracking trends in ambient water quality, approved trading programs include ambient monitoring requirements, and Ohio EPA conducts comprehensive water quality studies.

The use of water quality credits to comply with nutrient limits in NPDES permits is subject to the same tracking measures as described in the NPDES permit section. In addition, if a permit holder fails to comply with its nutrient limits due to "credit failure" (for example, extreme weather washing out a nonpoint source management practice), it must notify the Director within seven days and return to compliance within 90 days by either obtaining sufficient credits or reducing its nutrient discharge.

Adoption of Water Quality Standard Criteria for Nutrients

Year: Ongoing since 2002

Organizations: Ohio EPA, U.S. EPA

Description: Under the CWA, States must adopt WQS that meet minimum program content requirements. The principle requirements are:

- adopt standards that promote the "fishable swimmable" goals of the Act;
- identify beneficial uses for each body of water;
- have criteria to protect those uses; and,
- have an antidegradation policy that prevents unnecessary lowering of water quality and that protects all existing water body uses.

U.S. EPA published national water quality criteria recommendations for nutrients in 2002. Over the past decade U.S. EPA has consistently urged States to adopt criteria for nutrients. Ohio and 43 other States have established multi-year work plans that outline the steps being taken to develop and adopt water quality criteria for nutrients. Ohio EPA began work in 2002 to establish scientifically sound criteria tailored for conditions in Ohio. A scientific study was conducted to determine the empirical relationships between the amount of phosphorus and nitrogen in Ohio streams[1] and the biological responses that would be indicative of adverse impacts on beneficial use of water.

Ohio EPA began Early Stakeholder Outreach on nutrient criteria rules in March 2013. The Agency is seeking input on the basic form of the criteria (narrative vs. numeric), the underlying technical approach used to develop nutrient criteria and on the Division's initial proposals for the criteria applicable in rivers, streams and inland lakes. All these issues are under review and open for input from all interested parties. Additional information is available online at http://epa.ohio.gov/dsw/dswrules/nutrientcriteria.aspx.

Tracking Measures: A revised work plan will be prepared including additional steps to establish scientifically sound criteria for specific water body types (Lake Erie near-shore, open lake, inland lakes, Ohio River, other large rivers, smaller stream and rivers[1]). For each water body type, the status of completing administrative rule making steps will be tracked, including: Early Stakeholder Outreach; Interested Party Review of draft rules; proposed rules; adoption of final rules.

[1] Streams and rivers less than1,000 square miles in drainage area.

Ohio Department of Agriculture

Design Requirements For Bulk Dry Fertilizer Storage

Year: Ongoing since 1991

Organizations: Ohio Department of Agriculture – Division of Plant Health

Description: The Division of Plant Health requires dry bulk fertilizer to be stored inside a structure or device having a roof or cover, sidewalls, and a base sufficiently impermeable to prevent contact with precipitation and surface water if the material is stored for more than thirty days in any calendar year. Dry fertilizer materials and non-liquid fertilizer stored for thirty days or less in any calendar year may be stored outdoors provided they are placed on a ground cover sufficiently impermeable to prevent contact with precipitation and surface water and completely covered with a waterproof tarpaulin.

Tracking Measures: ODA conducts investigations of any complaints or reported spill incidents to determine or obtain compliance with these rules.

Design Requirements For Bulk Liquid Fertilizer Storage

Year: Ongoing since 1991

Organizations: Ohio Department of Agriculture – Division of Plant Health

Description: The Division of Plant Health requires locations with greater than 5,000 gallons of liquid fertilizer storage capacity to have secondary containment for all permanent storage vessels at that location. They require design review and approval for minimum volumetric capacity and generally accepted engineering standards.

Tracking Measures: All facilities are required to be inspected by ODA and approved for use prior to storing fertilizer in permanent storage vessels. ODA inspects any complaint or reported spill incident to determine or obtain compliance with these rules.

Livestock Environmental Permitting – Permit to Install

Year: Ongoing since 2002

Organizations: Ohio Department of Agriculture – Division of Livestock Environmental Permitting

Description: The Division of Livestock Environmental Permitting requires Permits-to-Install for any Large Concentrated Livestock Feeding facilities. These permits require geological explorations, setbacks from ground water, surface water, wells, neighbors, property lines and roads. They require design requirements for manure storage and treatment facilities following standards and specifications in Ohio rule for minimum storage, storm and freeboard requirements.

Tracking Measures: All facilities constructed under a PTI require quality control during construction, from both private engineers and consultants. ODA engineers also inspect facilities during construction and review all final construction quality control information and perform a final inspection prior to use or stocking of animals.

Livestock Environmental Permitting – Permit to Operate

Year: Ongoing since 2002

Organizations: Ohio Department of Agriculture – Division of Livestock Environmental Permitting

Description: The Division of Livestock Environmental Permitting requires five5 year renewable permits to operate from each Large Concentrated Animal Feeding Facility (CAFF). These permits include:

- Manure Management Plans – showing how each facility will meet requirements for storing, managing, land applying or distributing manure to other users.
- Insect and Rodent Control Plans – showing how insects and rodents will be monitored and controlled on a regular basis and how to address any unusual increases in activity.
- Mortality Management Plans – showing how ordinary mortality will be handled as well as the provisions for catastrophic mortality would be handled if that might occur.
- Emergency Management Plans – showing preplanning for any type of emergency that may occur, with emphasis on addressing manure spills at the facility or during manure transport and land application.
- Operating Records – each permit includes the details of what must be inspected and the requirements for keeping records of those activities.

Tracking Measures: Each facility is inspected on a regular basis one, two or three times a year depending on the facilities size, complexity and past violations. The facilities are completely inspected physically for structural integrity, manure and wastewater containment, operations and any signs of discharges. Inspectors also check random land application activities and operating records and compare those records with facility operating conditions. Additional inspections are conducted to follow up with areas of non-compliance and additional inspections are conducted if there are complaints received.

Livestock Environmental Permitting – Certified Livestock Manager

Year: Ongoing since 2003

Organizations: ODA – Division of Livestock Environmental Permitting

Description: The Division of Livestock Environmental Permitting requires Certification of any individual or business that handles and land applies more than 4,500 dry tons of solid manure or 25 million gallons of liquid manure per year and/or requires a certified individual at each Major Concentrated Livestock Feeding Facility (ten times the size requirements of a large CAFF).

Each certified individual must complete additional training in three core classes of Manure Management, Nutrient Management and Environmental Regulations and take an additional three electives which range from mortality composting, odor minimization, neighbor relations, stockpiling, water quality, emergency action plans, biosecurity, liability, soil testing, manure testing, recordkeeping, application of manure to growing crops and many others.

Then they must submit an application, including information regarding what they have learned at the training sessions as well as past experience and background in manure management.

Each Certified Livestock Manager must complete an additional 10 hours of training every three years to be able to renew their certification.

Tracking Measures: ODA conducts annual inspection of Certified Livestock Manager required to have inspections to ensure compliance with manure application regulations and maintenance of required land application records. ODA also inspects any complaint or reported spill incident.

Ohio Lake Erie Commission

Lake Erie Protection and Restoration Plan

Year: Published periodically by the Ohio Lake Erie Commission

Organizations: Ohio Lake Erie Commission with input from the member agencies of the Commission (Ohio EPA, ODNR, ODA, ODH, ODOT, ODSA)

Description: The Ohio Lake Erie Commission publishes *the Ohio Lake Erie Protection and Restoration Plan*. The Plan was last published in 2008 and is undergoing revision to be released in Summer 2013.

The *Lake Erie Protection & Restoration Plan 2008* (LEPR) outlines strategic actions the Ohio Lake Erie Commission and its member agencies will take towards the protection and restoration of Lake Erie and its watershed. The 2013 edition of the Lake Erie Protection and Restoration Plan (anticipated release June, 2013) will include the following twelve priority areas:

- Nonpoint Source Pollution
- Invasive Species
- Coastal Health
- Areas of Concern
- Toxic Pollutants
- Habitat and Species
- Indicators and Information
- Sustainable Development
- Water Withdrawals
- Climate Change
- Dredged Sediment Management
- Jobs and the Economy

Grant awards from the Lake Erie Protection Fund administered by the Ohio Lake Erie Commission must assist with the implementation of the *Lake Erie Protection & Restoration Plan*. The Lake Erie Protection Fund (LEPF) focuses on projects which lead to better management decisions, both for environmental protection and economic development. Ideally, LEPF projects would serve to answer a management question, supplement a larger implementation or capital project, or complete final evaluations of a process or concept prior to seeking larger funding awards.

Tracking Measures: Progress reports are published periodically on implementation of the action items contained within the *Plan*. The Lake Erie Commission also publishes the *Lake Erie Quality Index* on a ten year cycle, summarizing health and condition of the Ohio Lake Erie region. The *Index* serves as the overall benchmark on progress.

Lake Erie Protection Fund (LEPF) Grant program

Year: Ongoing

Organizations: Ohio Lake Erie Commission administers the LEPF. Eligible applicants to the Fund include:

- Research institutions
- Local municipalities, counties and townships
- Soil & water conservation districts
- 501(c)(3) nonprofit conservation organizations with land management responsibilities
- Watershed groups with local government sponsorship
- County and municipal park districts

Description: The Ohio Lake Erie Commission administers Ohio's Lake Erie Protection Fund (LEPF), which was established to help finance research and implementation projects aimed at protecting, preserving and restoring Lake Erie and its watershed. The Fund is supported by Ohioans who purchase a Lake Erie license plate displaying the Marblehead Lighthouse or the Toledo Harbor Lighthouse designed by Ohio artist Ben Richmond. Small grants are available to fund a wide variety of projects which provide a direct benefit to Lake Erie and its tributary watersheds in Ohio.

Projects must assist with the implementation of the *Lake Erie Protection & Restoration Plan 2008*. The Lake Erie Protection Fund focuses on projects which lead to better management decisions, both for environmental protection and economic development. Ideally, LEPF projects would serve to answer a management question, supplement a larger implementation or capital project, or complete final evaluations of a process or concept prior to seeking larger funding awards.

Tracking Measures: Tracking for funded projects is specific to the individual project. Some grant recipients continue to provide annual reports to the Commission while other projects provide a final report with results and outcomes. The Lake Erie Commission publishes the *Lake Erie Quality Index* on a ten year cycle, summarizing health and condition of the Ohio Lake Erie region.

Ohio Department of Natural Resources

Conservation Engineering and Technical Assistance

Year: Ongoing since 2000

Organizations: Ohio Department of Natural Resources – Division of Soil and Water Resources

Description: The Conservation Engineering and Technical Assistance (CETA) program within ODNR works to provide increased training and support to enable the Soil and Water Conservation Districts (SWCDs) to increase the number and quality of conservation practices installed by landowners to meet conservation needs. Division engineers develop standards and specifications that allow SWCDs to use new and improved technologies to assist rural landowners and landusers. Technical assistance and oversight is typically provided in the program areas listed below.

- Rural Drainage Systems and Conservation Works of Improvement – Ohio Revised Code 1515.08 provides mechanisms for SWCDs and County Engineers to implement rural drainage improvement projects throughout Ohio. Conservation engineers provide technical oversight for

Conservation Works of Improvement Projects and have developed a draft Ohio Rural Drainage Manual as part of this program. The goal of the manual is to provide methods and procedures for communities and landowners to follow to protect the integrity of Ohio's rural drainage infrastructure in a socially, economically and environmentally responsible manner.

- Agricultural Pollution Abatement – Ohio Revised Code 1511.02 states ODNR-DSWR "*Shall establish procedures for administration of rules for agricultural pollution abatement and urban sediment pollution abatement and for enforcement of rules for agricultural pollution abatement".* Ohio administrative code requires SWCDs and ODNR-DSWR to offer technical assistance to agricultural operations in violation of these rules. The vast majority of these projects/violations require the oversight of conservation engineers with a professional engineering license.

This program also provides oversight and assigns job approval authority to approximately 200 SWCD technicians. Conservation Engineers have developed a training and classification system program titled the Technician Develop Program, which includes 20 training modules.

Tracking Measures:

ODNR utilizes the Soil and Water Information Management System (SWIMS) to track technical projects where local cooperators are receiving technical assistance from the CETA program and Ohio's 88 SWCDs. Typical projects include animal waste storage structures, erosion control structures, wetland development, drainage improvement projects, storm water control and stream assessment/restoration. The CETA program also tracks the technical training modules offered through the Technician Develop Program and the number of students enrolled in the program.

Resource Management Program

Year: Ongoing since 2002

Organizations: Ohio Department of Natural Resources – Division of Soil and Water Resources
Ohio's Soil and Water Conservation Districts

Description: The Resource Management program within ODNR is responsible for implementing statewide agricultural and nonpoint source water pollution control programs. The primary focus of the resource management program area is administering the Agricultural Pollution Abatement Program (APAP). The APAP focuses on sediment, which is the largest pollutant to Ohio's waterways, and livestock manure, which contains other pollutants that can harm the aquatic environment, cause water quality problems in streams and can contaminate drinking water supplies.

SWCDs assist ODNR in implementing the APAP by providing landowners, farm operators and loggers technical assistance, advice and expertise and informing them of the level of conservation necessary to comply with the rules and standards. The resource management section within ODNR helps SWCDs by providing training and educational opportunities to assist them in resolving pollution problems. In most cases participation is voluntary; however, in the case of a pollution complaint for a non-permitted facility the division can take enforcement action when necessary. When situations cannot be resolved voluntarily, the division chief can issue an order against any person who fails to comply with the rules

and standards. The APAP has historically provided limited cost share dollars to implement agricultural pollution abatement Best Management Practices (BMPs) onto operations that voluntarily correct sources of agricultural pollution from sediment or livestock.

In 2010, Ohio Administrative Code 1501:15-5 was revised to create a designation for a watershed in distress. Due to harmful algal blooms and related water quality issues in the Grand Lake St. Marys region of Ohio, the region was declared as a watershed in distress. Nutrient management plans and facility inspections are now required for most all livestock operations within this approximate 50,000 acre watershed. The Resource Management Program provides oversight of this program and is currently in the process of review and approving nutrient management plans and performing site visits to all 155 livestock operations within the Grand Lake Saint Marys watershed.

Tracking Measures:

ODNR utilizes the Soil and Water Information Management System (SWIMS) to track the technical assistance provided by all 88 SWCDs implementing the APAP. This program tracks the following:

- Technical assistance hours provided to landowners for implementing agricultural pollution abatement best management practices,
- Number of complaints and violations inspected as per APAP rules (Ohio Revised Code 1511 & Ohio Administrative Code 1501:15-5), and
- Number of facilities required to develop and implement nutrient management plans as part of Watershed in Distress rules (Grand Lake St. Mary's region).

Western Lake Erie Nutrient Reduction Program

Year: 2013

Organizations: Ohio Department of Natural Resources – Division of Soil and Water Resources

Description:

Best Management Practices

ODNR will provide cost share to producers in the Western Lake Erie Basin priority areas as per one of four cost share BMP options detailed below. The following areas are being targeted in the Western Lake Erie Basin, Maumee River Watershed, Cedar-Portage River Watershed, (8 digit HUCs-04100005, 04100006, 04100008, 04100009, 041000010) in Henry County, Wood County, Putnam County, Defiance County and Hancock County

BMP 1: VRT nutrient application w/ cover crops (11,512 acres)
Soil testing will be performed with zone or grid sampling.

- A map identifying the nutrient levels will be developed and submitted.
- Prior to a VRT nutrient application, a cover crop will be established.
- VRT nutrient application of phosphorus (P) for a two year cycle will be applied according to the Tri-State Fertilize Recommendation; applications will not be made where soil test P values exceed 40 ppm or 80 pounds per acre.
- All requirements of USDA-NRCS standard 590 for nutrient application will be followed.

- Records of all nutrient applications will be kept and submitted.

BMP 2: VRT nutrient application w/ incorporation (15,181 acres)

- Soil testing will be performed with zone or grid sampling
- A map identifying the nutrient levels will be developed and submitted.
- VRT nutrient application of phosphorus (P) for a two year cycle will be applied according to the Tri-State Fertilize Recommendation; applications will not be made where soil test P values exceed 40 ppm or 80 pounds per acre.
- Within 48 hours of the nutrient application, the fertilizer will be incorporated.
- All requirements of USDA-NRCS standard 590 for nutrient application will be followed.
- Records of all nutrient applications will be kept and submitted.

BMP 3: Nutrient application w/ incorporation (1,345 acres)

- Soil testing by taking 15 cores on an area no larger than 25 acres.
- A map identifying the nutrient levels will be developed and submitted.
- A nutrient application of phosphorus (P) for a two year cycle will be applied via nutrient application equipment capable of incorporating fertilizer through banding or injection. This will be accomplished through planters, air seeders, or other equipment capable of incorporating the fertilizer. Fertilizer will be applied according to the Tri-State Fertilize Recommendation; applications will not be made where soil test P values exceed 40 ppm or 80 pounds per acre.
- All requirements of USDA-NRCS standard 590 for nutrient application will be followed.
- Records of all nutrient applications will be kept and submitted.

BMP 4: Control Drainage Structures (10,000 acres)

- Structures are being installed on systematic drainage systems outlet with a maximum of 2.5 feet of elevation change from the structure within a minimum 15 acre watershed.
- Structures and sub-mains are being installed on systematic drainage systems with a maximum of 2.5 feet of elevation change from the structure within a minimum 25 acre watershed
- Structures will be raised to within a foot of the surface after fall harvest operations and opened in the March of the following year.

Tracking Measures:

A map identifying the nutrient levels will be developed and submitted to the corresponding Soil and Water Conservation District (SWCD) in each county.

Records of all nutrient applications will be kept and submitted to the SWCD in each county. The SWCD staff will verify that phosphorus was not applied over the tri-state recommendations and the staff will verify the residue level after incorporation.

The SWCD staff will visually inspect the cover crop stand.

The SWCD staff will verify that the control drainage structures are raised each fall and lowered again in the spring for a period of three years. The staff will record the dates the structures are raised and lowered.

Stream Restoration and Morphology

Year: Ongoing

Organizations: Soil and Water Conservation Districts and other local entities.

Description: It is well known that healthy stream ecosystems and their associated floodplains and wetlands filter and assimilate nonpoint source pollution, including nutrients. The stream management and morphology program builds awareness by providing comments on projects proposing to relocate streams for development and/or those proposing to restore streams, using scientific assessments of the ecological services that can be enhanced by maximizing morphology of the channel and its relation to site conditions. Technical assistance is provided, depending on the complexity of the request, either by review of proposed plans, phone calls or site visits.

Tracking Measures: Frequency of service provided.

Watershed Action Plan State Endorsement

Year: Ongoing

Organizations: Soil and Water Conservation Districts and other local entities.

Description: Watershed Action Planning in Ohio is closely aligned with the Clean Water Act TMDL program. Local partnerships, typically with support of a watershed coordinator, develop detailed inventories and characterizations of their watershed including causes and sources of water quality problems. TMDL data is utilized as the primary source of information if one is available. Stakeholders then delineate specific corrective actions for each 12-digit Hydrologic Unit Code sub-watershed. Solutions are specific to type and number of BMPs or other methods needed, anticipated load reductions, timelines, responsible partners, and specific actions necessary to implement the agreed upon solutions. Nutrient runoff and enrichment of Ohio watersheds is one of the most common issues addressed by Ohio Watershed Action Plans. Ohio EPA Division of Surface Water and Ohio DNR Division of Soil and Water Resources endorse WAPs that meet Ohio and US EPA guidance.

Tracking Measures: Number of state-endorsed watershed action plans, and implementation as reported in the Ohio Annual Implementation Report compiled by DSWR.

Watershed Coordinator Grant Program

Year: Ongoing

Organizations: Local units of government and 501(c)(3) organizations

Description: The program provides grants to locally employed watershed coordinators. Watershed coordinators facilitate and lead local watershed partnerships in development and implementation of state-endorsed Watershed Action Plans (WAP). These plans, as described above, include delineation of problems, goals, objectives and actions agreed upon locally as feasible to reduce causes and sources of nonpoint source pollution, including nutrients. Watershed coordinators focus and concentrate available technical, financial and human resources to implement these plans.

Tracking Measures:

- Annual Implementation Report – tracks implementation reported to watershed coordinators by all partners within the watershed.
- Annual Funding Leverage Report – tracks grants and others funding aggregated for watershed implementation within the watershed with the leadership and support of the watershed coordinator.
- Semi-annual progress reports, which include tracking of deliverables focused on development of a WAP or "priority implementation projects."

Coastal Nonpoint Source Pollution Control Program

Year: Ongoing

Organizations: State of Ohio and implementing partners

Description: As a participant in the Coastal Management Program administered by the National Oceanic and Atmospheric Administration (NOAA), Ohio is required to implement a Coastal Nonpoint Source Pollution Control Program (CNSPCP), which describes how Ohio will implement 56 management measures throughout the Lake Erie Basin. The federally prescribed management measures are grouped by sector (e.g. agriculture, forestry, marinas, etc.) and serve as a kind of checklist of general goals that if incorporated into Ohio policies, programs and authorities will result in reduced nonpoint source pollution to Lake Erie. Nutrient sources from agriculture, home sewage treatment systems and others are identified in the program.

Tracking Measures:

- Federal approval of Ohio program (13 of 56 management measures remaining)
- Implementation of CNSPCP Plan recommendations
- Watersheds with state-endorsed watershed actions plans

Part 2

Federal Agencies, Universities and Non-governmental Organizations

Federal Agencies

To be added at later date.

Universities

Education, Demonstration and Research in Nutrient Utilization

Year: Ongoing

Organizations: Ohio State University Extension

Description:

Ohio State University Extension provides ongoing educational activities which include conferences, meetings, educational materials, newsletters, on farm demonstration plots and research activities targeted at proper nutrient utilization, crop response and water quality concerns. Target audiences have included farmers, agricultural retailers and the general public.

Specific goals in 2011-2013 have been 1) to increase the understanding of the role of dissolved reactive phosphorus (DRP) versus total phosphorus in today's water quality concerns in relation to harmful algal blooms (Cyanobacteria) in Ohio's Waters, 2) linking nutrient losses in surface and subsurface waters to production practices, 3) Utilization of 4R nutrient stewardship in relation to Ohio recommended practices and conditions focused on Tri-State Fertilizer Recommendations criteria and other supporting practices.

Programming in 2011-2012 was conducted at a total of 91 programs reaching 5,567 participants. Locations for education included:

- Forty-eight Production Agronomy programs reaching 3,142 farmer and 185 agricultural retailers,
- Forty-one Private Pesticide License Recertification sessions reaching 1,653 license holders, and
- Three agricultural retailers focused programs reaching 492 participants and three agricultural lender programs reaching 95 participants.

Educational activities related to water quality and nutrient management included several individual events. The Farm Science Review utilized demonstrations and on-site displays to reach over 120,000 visitors. The Conservation Tillage Conference educated 950 agricultural industry representatives and farmers. Finally, the Ohio Certified Crop Advisor School included 120 Ohio CCA certified participants.

A publication entitled Crop Observation and Recommendation Network (C.O.R.N.) reaches 3,100 e-mail subscribers and 30,000 website visitors monthly. The 42 issues include nutrient management and water quality BMP information. Additional mass media efforts on nutrient management and water quality information included the Ohio Country Journal with 20,000 circulations, Ohio Soybean News with 18,000 circulations and Our Ohio from Ohio Farm Bureau.

Tracking Measures:
Pre/post testing of program participants; after program evaluation of participants in agronomic programming; agricultural retailer's survey is a survey of agricultural retailer related to soil testing and nutrient management practices in their service areas; other informal evaluation and one on one consultations

Increasing Nutrient Management Plan Expertise in Blanchard Watershed

Year: Began October 1, 2012 and ends July 31, 2014.
Organizations: Ohio State University Extension
Description: The project is focused on increasing technical expertise in Nutrient Management Plan development among agricultural professionals working in the Blanchard River watershed in Ohio. The program will focus on use of NRCS approved software to develop nutrient management plans both in a group setting and with individualized instruction to help the participants complete their first plan. Additionally, fertilizer training on the proper rate, source, placement and timing will be taught for Ohio conditions and in consideration of crop production and water quality impacts. A system to report on results of the plan will be developed moving toward adaptive nutrient management. On-farm demonstration of phosphorus application practices and rate will be coordinated with the participating agricultural professionals. The stated goal is Nutrient Management plan adoption by 50,400 acres in the Blanchard Watershed.

Tracking Measures:
Educational program participation; number of acres with Nutrient Management Plan development

Evaluating/Updating the Ohio Phosphorus (P) Risk Index Using Field-Scale, Edge-of-Field Monitoring Data

Year: 2012 to 2016
Organizations: USDA-ARS, The Ohio State University, and Ohio State University Extension
Description: This project proposes to evaluate and revise and update the current Ohio Phosphorous Risk Index as necessary through use of field-scale, edge-of-field monitoring data. It will quantitatively integrate additional best management practice (BMP) options into the Ohio Phosphorous Index and develop a web-based, easy to use, interactive geographic information system (GIS) tool that allows producers to easily calculate their Ohio Phosphorous Index scores online. The project will also choose from a suite of additional BMP options to aid with management decisions to reduce their risk of phosphorous transport (Ohio Phosphorous Index scores). This web-based tool will also be used for education purposes and to actively promote increased implementation of the revised/enhanced Ohio Phosphorous Index. Significant statistical analyses will be required to evaluate/revise the Ohio Phosphorous Index, integrate additional BMP options and to develop the web-based interface.

Tracking Measures:
Edge of field study and tool development

Non-governmental Organizations

Voluntary certification program for nutrient management

Year: 2012

Organizations: Agri-business, producers; The Ohio State University; The Nature Conservancy; state government

Description: A certification program is being developed through an advisory committee led by agricultural industry and farmer representatives, with participation from The Ohio State University, state government and others, as well as facilitation by The Nature Conservancy. The certification program for nutrient management in the agricultural sector is focused on agricultural retailers who have a large market share. It is a proactive effort to make progress using a scientific approach to nutrient management and sustained crop production. It would be completely voluntary, with emphasis on application of the 4Rs to nutrient management, stewardship, record keeping and accountability verified by an objective third party. Parties meeting the requirements would be able to advertise themselves as having been certified.

Tracking Measures: Number of retailers participating; number of producers reached; number of acres reached. Longer term measures may include reductions in use of phosphorus and nitrogen; concentrations of nutrients in waters.

Western Lake Erie Basin Conservation Effects Assessment Project: Determining the Right Level of Agricultural Conservation for Freshwater Biodiversity

Year: 2012 - 2015

Organizations: USDA, Agricultural Research Service; The Nature Conservancy; The Ohio State University; Ohio Sea Grant

Description: How many acres of best management practices (BMPs) do we need in order to see an improvement in in-stream life? Where do those BMPs need to be placed in the watershed? The Nature Conservancy (TNC) staff and partners successfully linked Soil and Water Assessment Tool (SWAT) modeling to fishery data in the Saginaw Bay watershed of Lake Huron to predict outcomes of different levels of BMP implementation on fish. TNC's Indiana, Ohio and Michigan chapters are now partnering with the U.S. Department of Agriculture's Agricultural Research Service (ARS) as a part of the Natural Resource Conservation Service's Conservation Effects Assessment Project (CEAP), to build on this approach within the Western Lake Erie Basin. Working with ARS, The Ohio State University, and Ohio Sea Grant, will be modeling small sub-basins to assess the impacts of BMP implementation on both fish and aquatic macroinvertebrates. The project will take place from May 2012 – April 2015, and the outputs will help focus funding and conservation on places where conservation practices will most benefit biological communities across the basin.

Tracking Measures: Number of restoration needs established; number of and acres of BMP implementation; amount of riparian and in-stream habitat improved; amount of nutrient and sediment inputs reduced; resulting concentrations and loads of nutrients in streams; changes in ecological condition.

Promoting Nutrient Use Efficiency through the Adapt Networks

Year: 2008 - present

Organizations: Environmental Defense Fund, University of Connecticut, Simplified Technology Services, Nester Ag Management, G&K Concepts, Haselman Ag, Natural Resources Conservation Service, the Joyce Foundation.

Description: The Adapt Networks combine the use of spatial imagery, precision agriculture, on-farm trials and analytical tools for a holistic nutrient use efficiency program that farmers implement in collaboration with their trusted advisors. Certified Crop Advisors, working with client farmers, design field trials utilizing different methods for nutrient applications - including rate, timing, source and placement (the 4Rs) and test the results through strips trials, cornstalk nitrate tests, soil tests, aerial imagery and yields. The data and results from each season are shared with the farmers during winter meetings. After two to three seasons of participating in the program, farmers have much better information on which to base nutrient application decisions, and become more efficient and adept at fine-tuning the 4Rs for nitrogen and phosphorus.

Tracking Measures:

- Number of farmers and advisors participating in the program/acres farmed (see table) - there are other Adapt Networks active elsewhere, this table only includes the networks in the tri-state area

Adapt Network	# Farmers	# Guided Stalk fields	# Trials	# Total acres farmed
Maumee (IN and OH)	91	64	45	160,000
Grand Lake	24 benchmark 12 plots	4	4 N 3 starter 1 cover crop	2,500
SW Michigan	32	62	28	3,600
Lenawee County	20	18	20	31,000

- Results of field trials and precision ag tools
- Adoption by farmers of lower or more efficient nutrient use rates, as measured through farmer surveys (on average farmers report reducing N use by about 30 lbs/acre)
- Results and discussion presented in annual reports
- Starter phosphorus trial results (generally speaking, these show no yield benefit from Starter phosphorus use where soil phosphorus levels are considered adequate according to university guidelines)

Appendix B

Currently, Ohio has several different water quality criteria that work to address the problems caused by nutrient enrichment. These criteria are listed below.

Public Water Supply Criteria: OAC 3745-1-33 (Table 33-2) and OAC 3745-1-34 (Table 34-1)

Water quality criteria for the Lake Erie drainage basin and Ohio River drainage basin, respectively.

Total Nitrate-N + Nitrite-N 10 mg/l

Narrative Criteria: OAC 3745-1-04 Criteria applicable to all waters.

The following general water quality criteria shall apply to all surface waters of the state including mixing zones. To every extent practical and possible as determined by the director, these waters shall be:

D) Free from substances entering the waters as a result of human activity in concentrations that are toxic or harmful to human, animal or aquatic life and/or are rapidly lethal in the mixing zone;

(E) Free from nutrients entering the waters as a result of human activity in concentrations that create nuisance growths of aquatic weeds and algae;

Aesthetic Criteria: OAC 3745-1-07

Table 7-11. Statewide water quality criteria for the protection against adverse aesthetic conditions.

Chemical	Form[1]	Units[2]	IMZM[3]	OMZM[3]	Drinking
Phosphorus	T	mg/l	C	--	C

[1] T = total.

[2] mg/l = milligrams per liter (parts per million); □g/l = micrograms per liter (parts per billion).

[3] IMZM = inside mixing zone maximum; OMZM = outside mixing zone maximum.

[a b] .....

[c] Total phosphorus as P shall be limited to the extent necessary to prevent nuisance growths of algae, weeds, and slimes that result in a violation of the water quality criteria set forth in paragraph (E) of rule 3745-1-04 of the Administrative Code or, for public water supplies, that result in taste or odor problems. In areas where such nuisance growths exist, phosphorus discharges from point sources determined significant by the director shall not exceed a daily average of one milligram per liter as total P, or such stricter requirements as may be imposed by the director in accordance with the international joint commission (United States-Canada agreement).

DRAFT

Appendix C Early Stakeholder Outreach Factsheet (March 2013) – OAC 3745-1

Developing Rules to Reduce the Impacts of Nutrients in Surface Waters

FACT SHEET

Division of Surface Water
March 2013

Early Stakeholder Outreach – OAC 3745-1

Developing Rules to Reduce the Impacts of Nutrients in Surface Waters

What rulemaking is Ohio EPA considering?

Water quality standards (WQS, OAC 3745-1) establish the uses and criteria for how Ohio's surface waters will be managed and regulated. This rulemaking will address the need, and the most appropriate means to protect beneficial uses of water from adverse impacts due to cultural eutrophication. Cultural eutrophication is the result of releasing large amounts of nutrients into rivers and lakes. If left unchecked cultural eutrophication can result in harmful algal blooms, the depletion of dissolved oxygen and fish kills. Cultural eutrophication associated with high levels of phosphorus and nitrogen is one of the leading causes of impairment of aquatic life in Ohio's lakes, streams and rivers. Ohio EPA began working in 2002 to establish scientifically sound criteria and practical tests that will link excessive amounts of nutrients to the water quality problems that nutrients create. Ohio EPA is now ready to begin the process to adopt criteria to address cultural eutrophication.

What has Ohio EPA already done?

The Division of Surface Water (DSW) has designed and carried out studies on Ohio's lakes and rivers. These studies provide useful data for interpreting how aquatic systems in Ohio respond to increasing nutrients and other variables. Results of work conducted on Ohio streams have been peer reviewed and published in the scientific literature and additional technical review has occurred through the efforts of U.S. EPA. Over the past several years DSW has informally shared preliminary results of these studies and their possible application as a water quality standard with various interest groups.

What is the purpose of Early Stakeholder Outreach on rulemakings?

The first step in the rule-making process is for Ohio EPA to identify that a rule needs to be amended, rescinded, or created. In response to Executive Order 2011-01K, Ohio EPA has created the Early Stakeholder Outreach step in all rulemaking efforts to ensure that stakeholders are brought into the process at the initial rule assessment phase. This additional interested party notification and request for information will allow for early feedback regarding the need for the rule, its rationale and the likely impacts of new requirements on stakeholders. The goal is to gather constructive feedback from outside parties before rule language is drafted by the Agency.

Why are the rules to address nutrients necessary?

Two reasons: 1) there is clear evidence that waters in Ohio are harmed by excessive amount of nutrients (phosphorus and nitrogen); and 2) U.S. EPA is urging that all states address nutrient pollution through multiple lines of work, including the adoption of state strategies and effective regulations. Ohio EPA believes the full scope of water quality problems caused by cultural eutrophication cannot be addressed until better clean water standards are established. Action now will result in faster implementation of additional pollution control measures at point sources and the voluntary adoption of best management practices for nonpoint sources of phosphorus and nitrogen.

What will happen if Ohio does not adopt standards?

The pace of effectively dealing with the impacts caused by nutrient pollution will continue to lag behind the expanding scope of impairments seen in Ohio's rivers, inland lakes and especially downstream waters like Lake Erie, the Ohio River and the Gulf of Mexico. Prolonged delays in Ohio's rule adoption efforts could lead to actions by U.S. EPA to promulgate standards for Ohio. These standards would almost certainly be less flexible and result in more extensive business impacts compared to the approaches under consideration by Ohio EPA.

Early Stakeholder Outreach
for DSW's WQS Program

What are the differences between narrative and numeric criteria?

Federal and state WQS regulations accommodate two types of criteria, narrative or numeric. Both criteria are intended to protect the beneficial uses assigned to the water (for example drinking water or protection of aquatic life). Narrative criteria are descriptors of the conditions that support the beneficial use. Numeric criteria specify the amount and form of a specific substance or biological attribute measured in the water. This value becomes the threshold at which the beneficial use is considered impaired.

Ohio currently has broad narrative criteria covering nuisance algal conditions and phosphorus. Ohio EPA has used these regulatory provisions and studies done in the 1990s to list waters impaired by nutrients and to establish Total Maximum Daily Load (TMDL) target values for nutrients. Much has been learned over the past decade and this new information should be applied to update Ohio's standards.

What are the issues and the areas where public input is needed?

At this time Ohio EPA is seeking input on the basic form of the criteria (narrative vs. numeric), the underlying technical approach used to develop criteria and on the Division's preliminary ideas for the criteria applicable in rivers, streams and inland lakes. The attached table outlines the scope of what Ohio EPA believes will be necessary to protect our water resources. All these issues are under review and open for input from all interested parties.

What preliminary criteria has Ohio EPA considered?

For Streams and Rivers

Ohio EPA has studied over one hundred stream locations to develop empirical relationships between nutrient concentrations [total phosphorus (TP) and dissolved inorganic nitrogen (DIN)], chlorophyll a produced by benthic algae, dissolved oxygen and overall biological community health (Ohio's existing biological criteria). A multi-metric scoring system has been developed that aggregates results from separate evaluations of primary productivity, biological health and in-stream nutrient concentrations. The resulting output is a multi-metric scoring system referred to as the Trophic Index Criterion (TIC). The TIC provides an integration of "stressor" variables (nitrogen and phosphorus concentrations) that potentially cause stream degradation with "response" data collected through measurements of biologically important stream attributes.

The conceptual approach is summarized on the attached flow chart. If advanced through the administrative rulemaking process the TIC would be adopted in Ohio's WQS regulations as the criterion to protect the stream and river aquatic life use designations from adverse impacts of cultural eutrophication. Where the TIC indicates that aquatic life uses of a stream are either impaired or threatened due to cultural eutrophication, nutrients would be managed to restore ambient nutrient concentrations to levels below the use-appropriate targets derived from the relationships observed in the Ohio field data. Tentative target values are shown on the flow chart.

For Inland Lakes

Ohio EPA used the regional reference approach to develop criteria for inland lakes and released these draft standards for interested party review in 2008. Criteria for chlorophyll a, secchi disk transparency, total phosphorus and total nitrogen where developed and stratified where possible by lake type and ecoregion. Ohio EPA is currently re-calibrating the regional reference approach criteria calculations using additional data collected in the past 4 years.

Who will be directly regulated by this rulemaking?

These standards, once adopted, will be implemented in Clean Water Act (CWA) programs such as National Pollutant Discharge Elimination System (NPDES) permits and TMDL reports. Entities affected by these programs that discharge nutrients include municipalities, industries (especially food and fertilizer plants), commercial facilities and concentrated animal feeding operations.

Who will be indirectly affected by this rulemaking?

Everyone who expects and depends upon clean water that is useable for drinking, recreation and industrial purposes. Drinking water utilities, tourism and water based recreation businesses have the most obvious interests and potential for economic losses. The quality and economic value of Ohio's water resource depends upon reducing the pollution impacts cause by cultural eutrophication.

Agribusiness and individual producers could be indirectly affected by these rules. Agriculture is currently exempt from most CWA regulations so water quality criteria cannot be translated into specific individual producer requirements. However, the criteria may be used to identify waters impaired by nutrients. Once listed as a water body impaired by nutrients Ohio EPA is obligated to track the status of the water body to determine if pollution abatement efforts result in improvements. TMDLs may be prepared on impaired waters and the regulations should clearly articulate the restoration goals or TMDL targets. .

What is the rulemaking schedule?

The Agency is planning to release a draft version of the rules for interested party review and comment later in 2013.

What feedback is the Agency seeking?

The Agency wants to hear from all who may be impacted by this rulemaking. General comments and specific factual information are welcome. Ohio EPA is specifically asking for feedback on the following general and specific questions:

General Questions -

- Does this rulemaking impact your business?
- Does this rulemaking have an adverse impact on your business? If so, please identify the nature of the adverse impact (e.g., license fees, fines, employer time for compliance).
- Is there a need to for the rule? Are the preliminary concepts regarding the rule clear?
- Is there an alternative rulemaking (or specific provisions within the rule) that the Agency should consider?
- What are the benefits of the rulemaking?
- What are the costs of not adopting the criteria?

Specific questions –

- Should the Agency adopt narrative or adopt numeric nutrient criteria?
- Is there sufficient technical justification to adopt nutrient standards? For which type(s) of water bodies?
- Do you support the TIC criterion for streams and rivers? Is another approach preferable? Are the TMDL stream target values for DIN and TP used for calculating Waste Load Allocations (WLAs) and Water Quality Based Effluent Limits (WQBELs) reasonable?
- What other specific questions need to be addressed before proceeding with rule adoption?

What should I consider as I prepare my comments?

You may find the following suggestions helpful for preparing your comments:

1. Explain your views as clearly as possible.
2. Describe any assumptions that you used.
3. Provide any technical information and/or data you used that support your views.
4. If you estimate potential burden or costs, explain how you arrived at your estimate.
5. Provide specific examples to illustrate your concerns.
6. Offer alternatives.
7. Make sure to submit your comments by the comment period deadline.

Early Stakeholder Outreach
for DSW's WQS Program

How can I provide input on the rulemaking?

Please submit your comments in one of the following ways:

By email: dsw_rulecomments@epa.ohio.gov

By fax: (614) 644-2745

By postal mail: Rule Coordinator, Ohio EPA, Division of Surface Water, P.O. Box 1049, Columbus, OH 43216-1049

Comments on the rule must be received no later than 5:00 p.m. on May 22, 2013.

How can I get more information?

This fact sheet is available on the Division of Surface Water website at www.epa.ohio.gov/dsw/dswrules.aspx. Links to supporting documents are available below.

For more information about the rulemaking, please contact:

Dan Dudley
(614) 644-2876
dan.dudley@epa.ohio.gov

Supporting documents

Nutrients in General:

- Early stakeholder outreach chart for framing numeric nutrient criteria issues and the areas where public input is solicited (SEE ATTACHED PAGE)
- Ohio's Draft Nutrient Reduction Strategy Framework – available at: www.epa.ohio.gov/dsw/Home.aspx
- Director's Agricultural Nutrients and Water Quality Working Group – Final Report and Recommendations – available at: http://www.agri.ohio.gov/topnews/waterquality/docs/FINAL_REPORT_03-09-12.pdf
- Ohio EPA Point Source & Urban Runoff Nutrient Workgroup – Final Report and Recommendations – available at: www.epa.ohio.gov/dsw/Home.aspx
- Ohio Nutrient Forum Visioning Workshop – available at: www.epa.ohio.gov/dsw/wqs/NutrientReduction.aspx
- Ohio EPA's Association Between Nutrients, Habitat, and the Aquatic Biota of Ohio Rivers and Streams (1999) – available at: www.epa.ohio.gov/dsw/document_index/docindx.aspx

Nutrient Criteria for Lakes:

- 2010 Interested Party Review Draft Lake Habitat Criteria – available at: www.epa.ohio.gov/dsw/dswrules/nutrientcriteria.aspx
- Technical Support Document: Nutrient Criteria for Inland Lakes in Ohio, March 2010 - available at: www.epa.ohio.gov/dsw/rules/dswrules/nutrientcriteria.aspx
- Interested party comments on Draft Lake Habitat Criteria available upon request
- Ohio EPA DSW Inland Lakes program – available at: www.epa.ohio.gov/dsw/inland_lakes/index.aspx
- 2012 Integrated Report Section I, Consideration for Future Lists – available at: http://epa.ohio.gov/portals/35/tmdl/2012IntReport/IR12SectionIfinal.pdf

Early Stakeholder Outreach
for DSW's WQS Program

Nutrient Criteria for Streams & Rivers

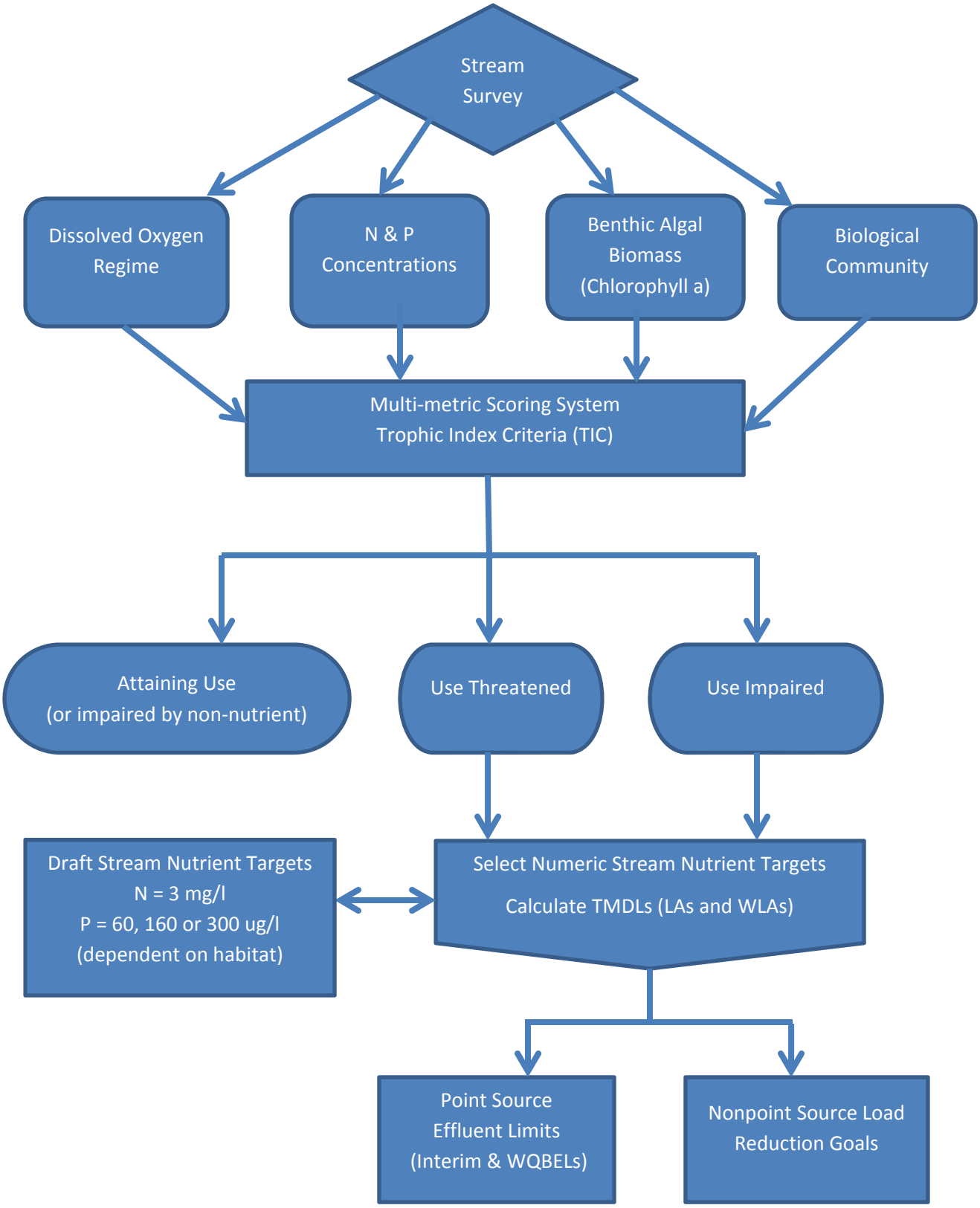
- Miltner, R. J. 2010. A method and rationale for deriving nutrient criteria for small rivers and streams in Ohio. Environmental Management 45:842-855 – available at: www.link.springer.com/article/10.1007%2Fs00267-010-9439-9
- Technical Support Document for Nutrient Water Quality Standards for Ohio Rivers and Streams. (Draft document prepared by Ohio EPA in cooperation with Tetra Tech and submitted to U.S. EPA on December 5, 2011.) – available at: www.epa.ohio.gov/Portals/35/rules/Nutrient_Criteria_Technical_Support_Document_12-2-2011%20DRAFT.pdf
- Trophic Index Criterion – Rationale and Scoring – available at: www.epa.ohio.gov/dsw/dswrules/nutrientcriteria.aspx

Other Resources

- Nutrients and the Mississippi River Basin / Gulf of Mexico – available at: www.water.epa.gov/type/watersheds/named/msbasin/index.cfm
- U.S. EPA – Nutrient Pollution Policy and Data – available at: www2.epa.gov/nutrient-policy-data

A chart that frames the nutrient standard issues and the areas where public input is being solicited during Ohio EPA's early stakeholder outreach process (March 2013).

Type of Water Body (where criteria apply)	**Primary Nutrient of Concern** & other parameters	Technical Approaches for Nutrient criteria – Available Options	Specific Standard as drafted by Ohio EPA
Lake Erie	**Total P** **Dissolved P** Chl a Secchi depth Nitrogen	1) Offshore, nearshore and tributary river mouth nutrient targets set out in Lake Erie Binational Nutrient Management Strategy (Lake Erie LaMP. 2011) 2) other	None at this time
Inland lakes and reservoirs	**Total P** Chl a Secchi depth Dissolved Oxygen Nitrogen	1) Regional reference model 2) Stressor response model 3) Recreational use impairment management model 4) other	Using regional reference model - draft criteria for each parameter listed; values vary by lake type and region of the State (proposed rules were withdrawn in February 2012)
Streams and rivers	**Total P** DIN Chl a Dissolved Oxygen Biological criteria	1) Stressor response model, parameters weighed collectively 2) Stressor response model, each parameter considered separately 3) Regional reference model 4) other	Using stressor response model – Trophic Index Criterion, incorporating the parameters listed; associated TP and DIN target values provided and applied in TMDL and permit programs
Ohio River & Gulf of Mexico	**Nitrogen** Phosphorus	1) Reduction goal established by Gulf hypoxia task force 2) other	None at this time



Conceptual design of the Trophic Index Criterion